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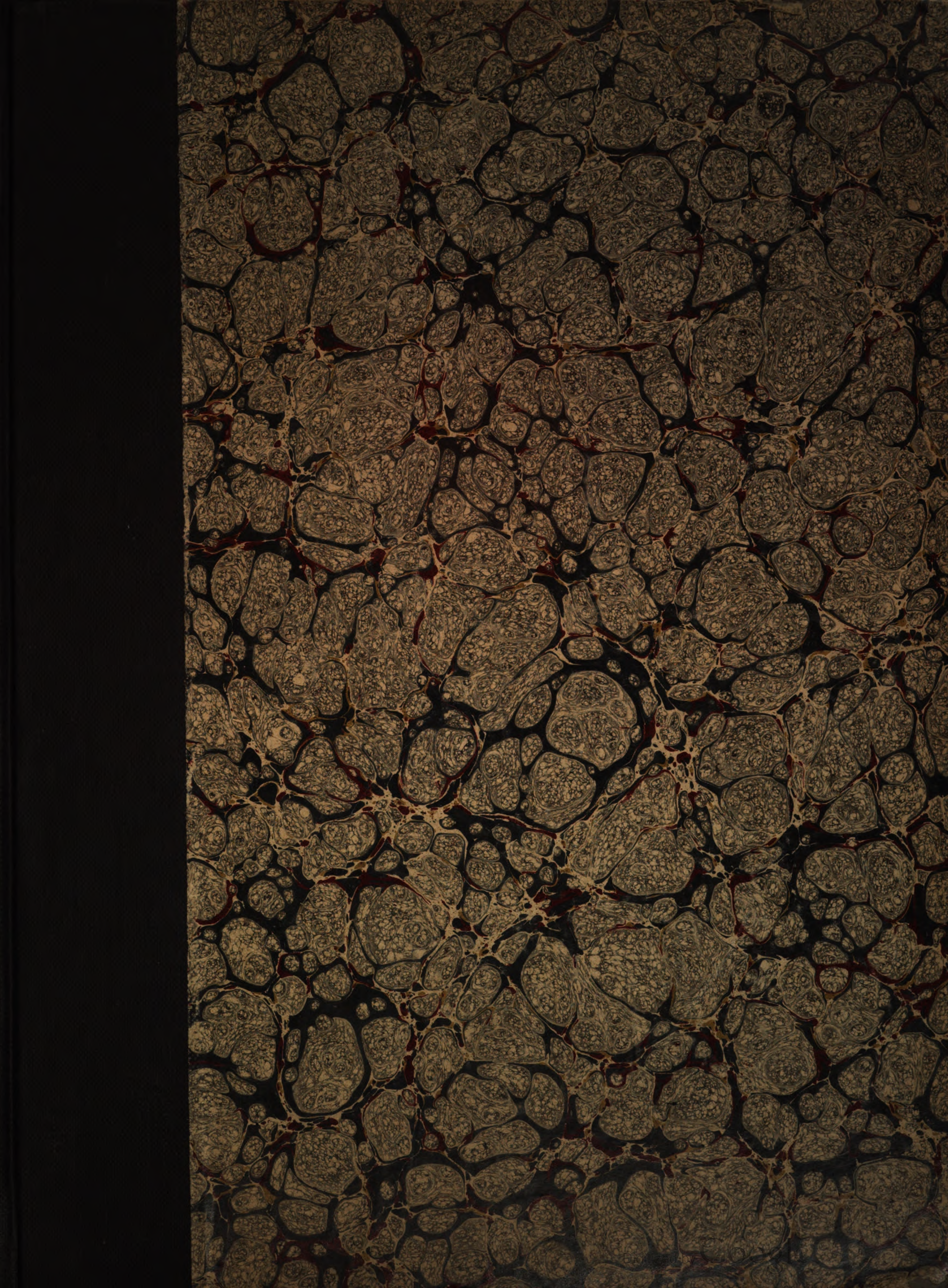

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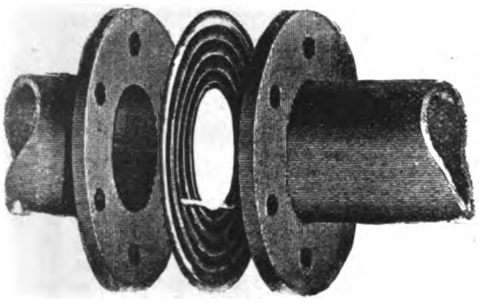

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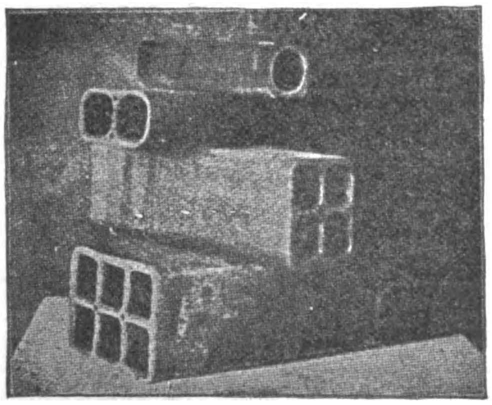

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EDITORIAL NOTES.

A Word About "Electricity."

As a general rule we do not consider it either seemly or becoming for a journal to "blow its own horn." This issue, however, being the first of the New Year, we deem it necessary to call our readers' attention to a few features of ELECTRICITY as they were last year and as we propose to make them during the next twelve months.

During 1904 there appeared in the columns of this journal, besides a large number of excellent short articles, several serials by authoritative writers. The subjects covered by the latter were electrical station practice, steam boiler pressures, Corliss engines and electric wiring.

At the present time a serial entitled "Electricity Leaflets" is running, which should prove of great value to the practical man who wishes to more thoroughly familiarize himself with the subject of electrical engineering. During 1905 our intention is to present to our subscribers articles of merit by well-known writers, both in this country and abroad. These articles will be up-to-date and will be devoid of hieroglyphics and intricate mathematics, but will nevertheless be technically correct.

The General News Department will be carefully looked after and every effort made to publish as early as possible information as to where bids are wanted.

That our efforts during 1904 have been appreciated may be inferred from the large number of new subscribers that have been added to our list. More will be added this year and it is our intention and determination to give to the public for $1 a year so large and choice an amount of reading matter that they will feel compelled to subscribe.

Oil as a Power Producer.

Illimitable coal fields do not compensate for the costliness of steam power producers. The inherent defect remains as ineradicable to-day as in the past. The unfortunate items of radiation and condensation, of heat escaping up the chimney and combustive processes which represent heavy losses—all of these, summed up, are the total which detracts from the whole, which levels beautiful theories to the ground and makes all improvements merely fancy frills to a finished and unchangeable fabric. The defects referred to as ineradicable are the natural defects of reciprocating steam engines. But this does not mean that such gloomy conclusions must be drawn with respect to other reciprocating forms of power producers. This is not the case, for instance, with the gas or oil engine, and particularly not the case with regard to those engines which utilize crude oil.

Nature has stored away deep down in the bowels of the earth vast reservoirs of oil. Here, as one of the last feats performed by this economical and perpetually busy housewife, she has gathered up from the gigantic pits which served as graves for her prehistoric forests, in vast subterranean pools, the exudations of these slowly carbonizing masses—known to-day by the descriptive and explicit title of "natural oil."

This, perhaps is the savior of mankind in the field of cheap electric power production, and in this respect it must be stated that oil engines carry within themselves hosts of possibilities of the utmost importance to theoreticians, engineers and financiers.

And why is this so? may be very properly asked by those whose curiosity cannot find an adequate response without help from technical statistics. The reasons briefly stated are these: Engines which consume crude oil successfully are far ahead in cheapness of operation of those depending upon other forms of combustible fluids. Both efficiency and cheapness can claim prominence in this category of advantages. Then comes the important feature of a concentrated form of fuel. Liquid fuel is certainly the advance agent of progress. Take the Diesel engine in which ignition of the oil in a highly desiccated form takes place through it coming in contact with a portion of air so highly compressed that its temperature rises to a point which excites combustion. Here, then, is an engine which represents certain theoretical ideals which have been largely crystallized in its construction. It consumes a crude form of oil; its cheapness of operation gives it prominence without further comment. It is a type of the oil consuming engine which threatens to predominate in the near future. It is not mentioned here except as a unique type which offers a solution of that all-important problem, "cheap electricity." Coal has had its day, not because it is not a cheap and satisfactory fuel, but because the steam engine is about to undergo a great revolution in construction. And this revolution is but the beginning of a series of vast changes in the economy of electric power houses, which must lead to the production of electricity for the public at prices the humblest of homes can pay.

* * *

Refuse Burning and Electricity Generation.

The most exhaustive independent examination that has yet been made of the actual steam raising values obtained in the working of combined dust destructors and electricity works is that recently issued by an English consulting electrical engineer, Mr. W. P. Adams. In the course of detailed analyses of the results which have been recorded by the engineers of different types of plants in different parts of the United Kingdom, he has obtained figures which afford convincing evidence that great advances have been made in the problem of utilizing waste heat since the pioneering destructor installations were put down. The results still leave room for substantial improvement, however, by closer attention to the details of construction of furnaces and flues, and the general arrangement of the plant; also by improving the methods of handling and burning the refuse, by careful utilization of the steam generated, and by the adoption of an economical form of blast. Mr. Adams expresses the conviction that, given suitable conditions, there is undoubtedly a substantial gain to be affected by the combination of electricity and destructor works; but owing to the variation in the calorific value of refuse in different localities, and to other special local considerations, every proposed case of combination needs to be considered on its merits by persons qualified to make an independent and intelligent inquiry. Wherever such combined undertakings exist it is most desirable that the accounts of each department be separately kept so that it may be possible to have a true record of the real extent of the value of combination.

To English electrical engineers especially, Mr. Adams' collection of data is of great value because of the many plants that have lately been erected and because of the increasing popularity of combined systems with municipal authorities in England. The paper, which was read before the London Institution of Electrical Engineers on December 15, contains many statistical tables of interest.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The Cleveland (O.) Electric Company will experiment in 3-cent fares for a distance of two miles from the center of the city.

At the recent meeting of the Benjamin Franklin fund managers in Boston a letter was read from President Henry S. Pritchett of the Massachusetts Institute of Technology containing a proposition from Andrew Carnegie to duplicate the amount of the fund, which has now reached $400,000, provided the total be devoted to the establishment of a school for the industrial training of men and women along the lines of the Mechanics and Tradesmen's School, of New York, and the Cooper Union, the city of Boston to furnish a site. The board voted to thank Mr. Carnegie for his offer and to give the matter early consideration.

Chief Engineer William Barclay Parsons has submitted to the New York Rapid Transit Commission plans for additional lines in Manhattan, the Bronx and Brooklyn, which, if carried out, are calculated to go far toward solving the rapid transit problem. The estimated cost of the proposed new lines in Manhattan is about $40,000,000 and the extension of the Subway system in the Bronx and Brooklyn will involve an outlay of $9,000,000. The Commission will hold a public hearing a week from next Thursday.

Rear Admiral Colby M. Chester, in charge of the United States Observatory at Washington, D. C., on Monday night received a cablegram from Sydney, Australia, indicating that the New Year's flash to that point on New Year's night, broke the record. The flash went from Washington to Sydney, 12,000 miles, over relays, in 2.96 seconds. "This," said Lenehan, operator at Sydney, "is a triumph for the electrical department of the American Observatory. Congratulations."

It is announced officially that the Merchant's Association of New York is preparing for submission to the Legislature an act to regulate the price of electric lighting in the same way as the price of gas is now regulated. The act will apply to private consumers as well as to the city, and there will be a unit of price—so much per kilowatt hour—with penalties for violations of the act.

Ningpo, China, is shortly to have an electric lighting plant which will supply 4,000 lights.

Consul Nason reports from Grenoble, France, that the utilization of the enormous power of the mountain streams and glaciers, called the "white coal," is year by year attaining larger proportions. The last achievement is the lighting of the entire city by electricity generated 27 miles away. Ornate standards, 30 feet high, with curving pendants terminating with powerful arc lights, have been erected in the streets, and the full illumination, after a period of testing, is soon to be made the object of a festival night.

A civil service examination will be held in Cleveland, O., January 18 for aids and laboratory apprentices, Department of Commerce and Labor. January 18-19 there will be examinations for inspectors of mechanical and electrical engineering in the office of the supervising architect and assistants to the chief inspector of the quartermaster's department at Philadelphia. The position of laboratory aids and apprentices will pay $480 a year, engineering inspectors $2,190 a year and assistant to the chief inspector $1,500 a year.

The submarine tunnel connecting Boston and East Boston was opened for public travel last Friday. About 40 trolley cars of special adaptability are in use.

TELEPHONE PROTECTIVE DEVICES.

BY RALPH SCOTT.

A telephone arrester or diverter is a device for protecting a telephone from injury by lightning or other static high potential discharges. These discharges are usually the result of the tendency of the atmospheric electricity to pass to ground. When lightning strikes a telephone line wire, it passes along this line to the nearest instrument or set of instruments and thence to ground, depending upon the facilities which have been provided for its escape. An unprotected instrument is at best a hazardous unit during a lightning storm, either to itself or to the adjacent person or buildings.

The protection of telephone circuits has become lately a very important matter, both to the subscriber and also to the company. The subscriber looks at the question of lightning protection from a view of security and safety, since there are numerous cases with which he is familiar, of poorly protected telephones being frequently the cause of dangerous fires or accidents.

The company, on the other hand, views complete protection from the standpoint of the saving of apparatus, since its experience has shown that a small outlay in protective devices is usually more than compensated by the minimizing of the loss of instruments due to the destructive discharge.

In designing an arrester which will be satisfactory, therefore, it is necessary to consider both the subscriber and the company, so that the protection afforded will be both a means of saving property or life, and also the means of saving the instrument to which the device is connected.

Much effort has been expended in devising and improving arresters for telephone protection. A discharge of lightning that would not affect a telegraph instrument or similar appliance would be absolutely fatal to a telephone. This is because of the fact that a telephone contains a number of flimsy and minute devices that require but little disturbance to be put out of order. Also it is not safe to allow an impeded lightning discharge to enter a house or other building without a safe means of escaping to the ground.

When telephony had not as yet become an established industry it was classed in construction work in the same light as the then well-established telegraphy. The line construction, together with the installation of the central offices, was placed in the hands of men experienced in the art of telegraphy. The result of the reversion was the pressing into service of construction and protection material which has become standard in telegraph work. As high tension circuits were not at that time as frequent as at the present, the only trouble which had to be guarded against was that caused by lightning. For the protection of the instruments and stations against lightning, telegraph lightning arresters were employed.

These arresters consisted of metal plates separated by an air-gap or by a piece of paraffined paper. This arrester proved fairly efficient for separate line work, but when cables were introduced its operation was entirely unsatisfactory. The result was the new designs of arresters were attempted, among the earliest of which was that formed by wrapping a few turns of wire around a grounded rod, this wire being insulated from the rod by means of paper. This device proved itself fairly effective, but the increased use of high tension currents and the extension of trolley system brought further trouble which could not be obviated by this device. This trouble, known as foreign currents, brought about the construction of an entirely different set of apparatus, which at the present time is in a remarkable state of perfection. The forerunner of these protectors was an electric magnet in series with which was a circuit opener operated by the magnet itself. When a current passed through the magnet which was stronger than the allowable amount, the circuit was opened by the magnet much in the manner of an overload circuit breaker.

A lightning or other static discharge consists of an enormous number of oscillatory surges. It has been estimated that a discharge of lightning consists in reality of about 100,000,000 surgings back and forth; although it is probable that the entire flash does not occupy more than one-millionth of a second. By reason of this frequency such a discharge will not pass through even a very slight impedance. On account of its enormously high potential, however, it will readily pass through a very high ohmic resistance, providing this resistance be in a perfectly straight line.

To show the effects of impedance, the loop shown in Fig. 1 should be considered. If a discharge of lightning passes initially from E to S, the loop L, and the curves 00 will offer such a great amount of impedance that the discharge will jump across the air-gap at A.

The formula for impedance in ohms is:

$$\sqrt{R^2 + (2 \times 3.1416\ n\,L)^2}$$

In which n is the frequency, R the resistance and L the inductance. On account of the great value which n has when dealing with lightning it is seen that the impedance becomes great even though L is small.

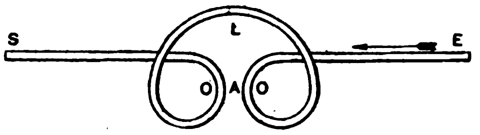


Fig. 1.

The surges which occur during the lightning discharge are shown diagrammatically in Fig. 2, being alternately positive and negative in direction, and gradually decreasing in intensity, as shown by the position of the ordinates with respect to the line AB.

The effect of inductance may be given the following mechanical analogy: Suppose that a wheel provided with spokes be set in motion by a crank which is so solidly constructed as to be unbreakable. If now the wheel be set in back and forth motion by this crank slowly, the strain imposed upon the spokes by reason of the inertia of the rim will be very small. If, however, the wheel be quickly started, in first one direction and then another, the strain upon the spokes will be increased. If such motion be set up very rapidly the spokes will be broken.

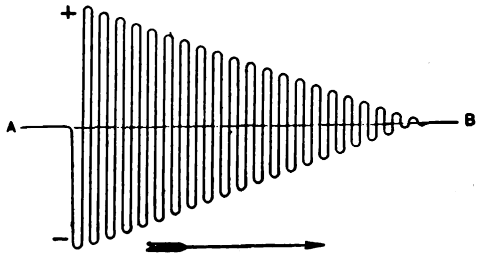


Fig. 2.

The exact nature of the lightning discharge is not understood, although recently considerable discussion and research has been carried out for the purpose of increasing this knowledge. In view of this research a summarization shows that the uncertainty of the action of lightning is known to a far greater degree than formerly. The result is that definite laws which might be laid down as covering the theory of lightning seem farther off at the present time than ever before.

The best answer that can be given to the question, "How may apparatus be best protected?" is: by providing as many paths as possible for the lightning to escape to the earth.

It is well known that such a discharge has certain selective tendencies, which are not greatly overcome by ohmic resistance, but are much so by the slightest impedance. The paths to the ground should be provided at such points as it is known that the lightning is most likely to pass.

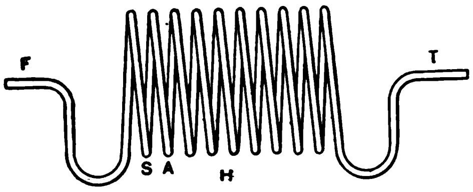


FIG. 3.

If we consider the solenoid H, shown in Fig. 3, then a discharge passing between F and T will jump across the air-gap separating the coils S, A, etc., rather than pass around the coils themselves.

It is this principle which led to the early use of the arrangement shown in Fig. 4; this consists of a metal cylinder O, around which a coil C is wound, this coil being insulated from O by means of a fiber or mica; one end N of this coil being connected to a line wire, and the other end U to the instrument to be protected. The cylinder is grounded at G. When a discharge passes through this arrangement it will jump from the layers of the coil to the cylinder, thus passing to ground.

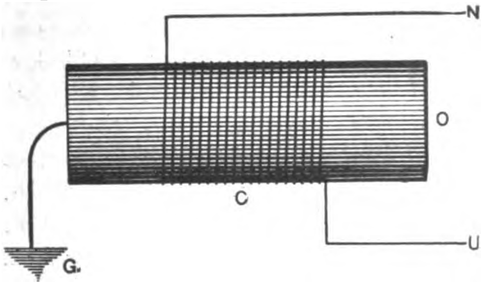


FIG. 4.

On account of the high resistance offered to a discharge by an inductive conducting medium it is evident that the arrangement shown in Fig. 5, which is often used in setting up telephones, is dangerous. The wireman, in installing a telephone, usually forms helices at the ends of the wires, which connect to the instrument and ground, these being formed of a number of turns. Connected to the binding posts H, A and S of the telephone E, are the ends of the coils F, T and Y. It is evident that such an arrangement offers a great resistance to an incoming lightning discharge, and prevents, in a great measure, its escaping to the ground by the required path.

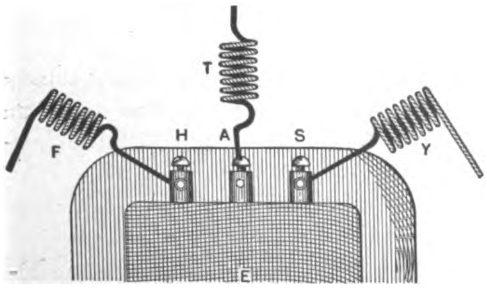


FIG. 5.

The disadvantage of an arrester formed of carbon blocks separated by a piece of paper or mica, is the fact that a heavy discharge is liable to produce a carbonization of the paper and thus connect electrically the two blocks, which connect the instrument to the ground. This action is shown in Fig. 6, which gives a section of a paper sheet that has been thus punctured. While a comparatively large amount of equidistant discharging area will prevent in a great measure this action, it is usually best after a severe lightning storm to replace the separating medium in such arresters as have been in operation.

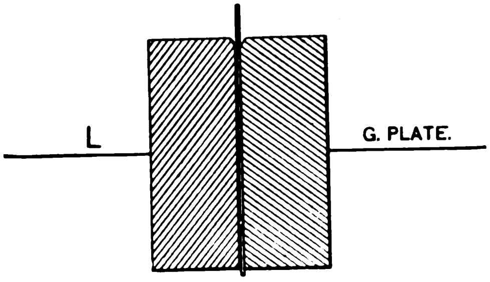


FIG. 6.

An arrester that works successfully on telegraph or signal line would not necessarily be practicable for application to a telephone. For this reason special appliances are employed, which, while seemingly flimsy and makeshift from a construction point of view, are capable of performing their work well.

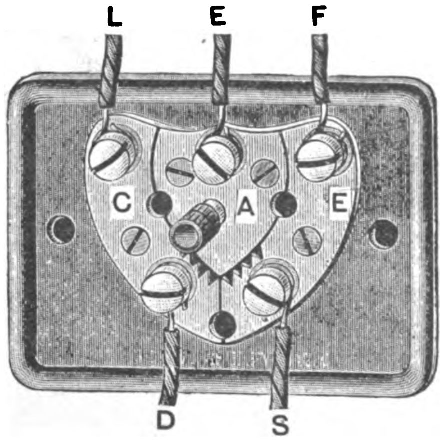


FIG. 7.

A good telephone arrester will fulfill the following conditions—first, be economical in construction; second, be of small size and pleasing appearance; third, offer the best possible path to ground for a high potential discharge.

Although brass plates, either separated by mica or paper, or provided with points, have been used very largely in arrester construction, long practice has shown that carbon, separated by a thin sheet of special paper is to be preferred. The necessary construction and consequent cost are reduced by this substitution, with perhaps an increase in efficiency.

When carbon is oxidized, the resulting compound, CO_2, is a gas, which readily passes off, leaving the oxidized surface in a better condition than before. The similar oxidation of metals on the other hand is liable to result in fusing the plates together. This, and the higher cost of the metals, has argued against their use.

Arresters for telephone purposes are used at the central office for every line and also at each instrument. With long lines it is frequently necessary to include intermediate arresters. They are also used at sub-stations and line junctions. It will be thus seen that a large number are used even on a small system. This renders imperative the use of a device that takes up but little space.

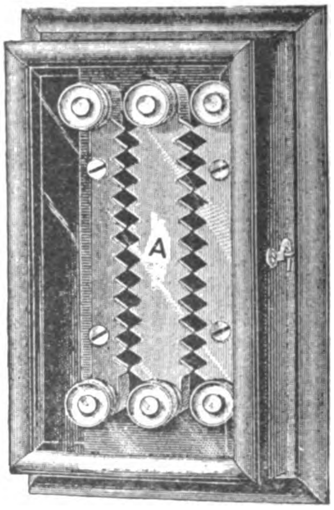


FIG. 8.

The simplest arrester made, but doubtless the most inefficient, is known as the saw-tooth arrester, two forms of which are shown in Figs. 7 and 8. Describing that shown in Fig. 7, we have: Upon a suitable insulating base are mounted the brass plates C, A and E, these being of the form shown. Connected to these outer parts are the line wires L and F and the instrument wires D and S. The plate A is connected to ground by the wire E. Plates C and E are provided with points or saw teeth, the purpose of which is to allow the high potential discharges to pass to the earth.

It is a well-known fact that static electricity passes more readily from a point to a plate than from a plate to a plate, hence the object of this construction. This arrester is also provided with a plug, by means of which the instrument may be cut out, leaving the line continuous. This feature is especially valuable for series party lines. The plug may also be used to connect either line to ground.

In Fig. 8 a modified form of saw-tooth

arrester is shown, The ground plate A, centrally located, is provided on both sides with teeth. This device was formerly used for telephones that are "bunched."

(*To be continued.*)

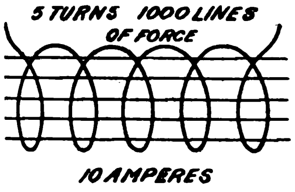
ELECTRICITY LEAFLETS.

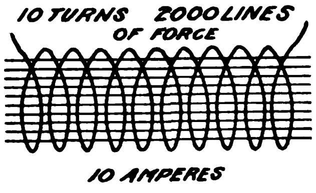
BY NEWTON HARRISON, E. E.

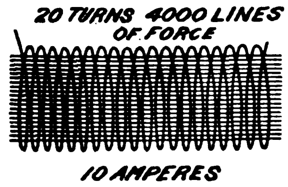
ELECTRO-MAGNETISM.

Laws of Electro-Magnetism.—In practical work it is possible to calculate with the greatest accuracy results in electro-magnetism by using a simple law embracing all of its applications. In order to fully grasp the idea it represents it is necessary to know the meaning of the constituents by which it is presented for practical use and through which the relationship between the parts of an electro-magnetic circuit are best understood.

Magneto-motive Force.—The electromagnet consists of a coil of wire carrying a current and either possessing a core of iron or not as the circumstances require. It is easy to see that the production of magnetism depends upon the number of loops of wire carrying a current. It is also evident that not only are the number of loops to be considered but the strength of current they carry as well. Here, then, is the point involved: That the greater the number of turns or loops of wire and the greater the current in these turns the greater the magnetic effect produced in total.







Ampere Turns.—It is customary to speak of the loops of wire as turns and the combination of current and turns as *ampere turns.* From a purely physical standpoint the "magnetism producing" elements of an electro-magnet are the ampere turns. These are obtained by multiplying the turns of wire composing the magnet by the amperes passing through, the total representing ampere turns. For instance, if an electro-magnet consists of 1,000 turns carrying a current of 10 amperes, the ampere turns = 10 × 1,000 = 10,000 ampere turns. If the turns are 1,000 and the current $\frac{1}{10}$ of an ampere then the product = $\frac{1}{10}$ × 1,000 = 100 ampere turns. But the case may be slightly different if, for example, there are 10,000 turns and 1 ampere or 1 turn and 10,000 amperes. In either case the total ampere turns = 10,000 which means that the *magneto-motive force* is the same.

In calculating the magneto-motive force the ampere turns are multiplied by 4π giving as the complete value $4\pi n c$ where π 3.1416, n = turns, c = amperes. For instance, the magneto-motive force of a coil of 1,000 turns carrying 10 amperes is equal to 4 × 3.1416 × 10 × 1,000, = 125,664. If the current is reduced the magneto-motive force reduces correspondingly, and the power of the coil to force magnetism through an iron bar is also reduced.

The idea, therefore, associated with magneto-motive force is the power of the ampere turns to force magnetism at a certain strength through a bar of iron. If the bar is long it would require more magneto-motive force to produce a certain number of lines of force throughout than if the bar is short. In other words, the dimensions of the iron bar, its length, breadth and thickness, will have to be considered in conjunction with the magneto-motive force in order to arrive at a clear and adequate idea of the conditions governing the development of a magnetic field produced by electro-magnetism.

Law of Electro-magnetism.—The law of electro-magnetism states that "the magnetic flux is directly proportional to the magneto-motive force and inversely proportional to the magnetic reluctance." This can be represented in the following form:

$$\text{Magnetic Flux} = \frac{\text{Magneto-motive Force}}{\text{Magnetic Reluctance}}$$

The magnetic flux and reluctance will each be treated separately and will be found to represent respectively, first, the number of lines of force produced, and, secondly, the conditions through which the magneto-motive force must operate to produce the magnetic flux; said conditions consisting of the dimensions of the space or material through which the magnetism is being produced and the permeability of the material magnetized.

Magnetic Reluctance.—The reluctance of the material to be magnetized calls for a greater or less magneto-motive force to produce a given magnetic flux, the same as the greater the resistance of an electric circuit the greater the electro-motive force required to send through it a current of given strength. The reluctance of any magnetic circuit must consist of four items, three of which are dimensions and the fourth is a native peculiarity of the material called permeability. The dimensions are naturally the length, breadth and thickness or the length and cross-section of the material undergoing magnetization.

Permeability.—Permeability is sometimes called the ratio between the lines of force in iron and the lines of force in air.

$$\text{Permeability of Iron} = \frac{\text{Lines of force in a magnetized bar}}{\text{lines of force without iron}}$$

For instance, if the magneto-motive force of a coil carrying a certain current produces 10,000 lines of force in air, which when a bar of iron is inserted increase to 10,000,000, then the permeability or multiplying power of the iron can be represented by the ratio of 10,000,000 to 10,000, or permeability = 10,000,000 ÷ 10,000 = 1,000.

Many cases can be cited to illustrate the meaning of permeability in iron, steel or air which would disclose the fact that in the softer grades of iron like wrought iron and mild steel the permeability is higher than in cast iron or any of its modifications.

Air as a Standard of Permeability.—Air is taken as a standard of permeability and is called 1. In comparison the magnetizable metals rate very high and range according to the following schedule as regards their permeability:

Air	1
Cast Iron	800
Mild Steel	2,000
Wrought Iron	3,000

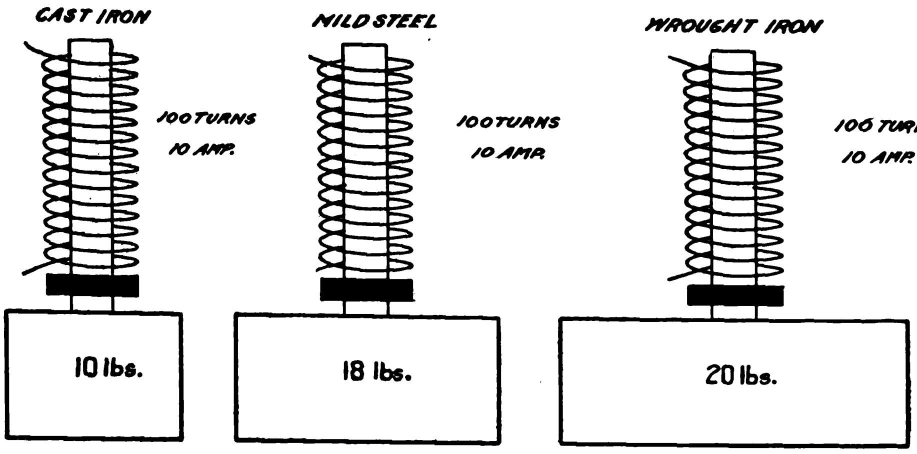
The result of a lower permeability is less lines of force when the same magnetizing force is employed by means of a coil.

This idea can be well represented by making three bars of cast, wrought iron and steel of exactly the same dimensions and placing them in three coils of the same number of turns and supplied with exactly the same current apiece. This would give the same magneto-motive force to each coil and the same dimensions to each magnetizable bar; the only difference would be found in the different permeabilities of the metals respectively.

The law that the magnetic flux is proportional to the magneto-motive force and inversely proportional to the reluct ance can now be represented symbolically as follows:

$$F = \frac{\text{M. M. F.}}{\text{R}}$$

Where F = flux, M M F = magneto-motive force and R = reluctance. If the magneto-motive force can be represented by 4π n c and the permeability is represented by the Greek character μ, then the flux can be calculated by the following formula which presents exactly the same proposition but has given a symbol, and a value in consequence, to all the elements which compose a problem in electro-magnetism:



$$\text{Lines of force} = \frac{4 \times \pi \times \text{n} \times \text{c} \times \mu \times \text{q}}{10 \times \text{l}}$$

Where 4π n c = magneto-motive force.
μ = permeability.
q = cross section of iron in square centimeters.
l = length of iron in centimeters.

To show the application of the formula suppose a coil has 500 turns and carries 2 amperes. The iron has 10 square centimeters cross section and is 20 centimeters long with a permeability at that point of magnetization of 1,000; how many lines of force will be produced?

$$\text{Lines of force} = \frac{4 \times 3.1416 \times 500 \times 2 \times 1{,}000 \times 10}{10 \times 20}$$

Lines of force = 628,320.

The formula can be transformed to suit the requirements of the English system by calling every centimeter .4 of an inch, or 1 inch = 2.5 centimeters, and every square inch equal to 6.25 square centimeters.

If the formula is carefully examined it will be found to consist of 4π n c, the magneto-motive force and permeability and cross-section in the numerator. If these symbols are placed below in the denominator the formula would appear in this form:

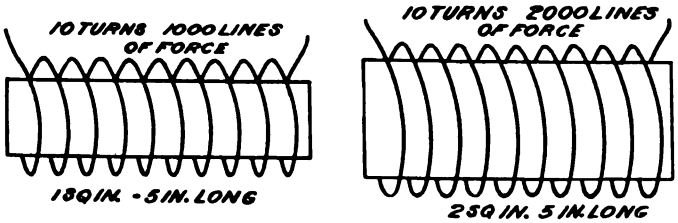
$$\text{Lines of force} = \frac{4\pi \text{ n c}}{10\left(\frac{1}{\mu \text{q}}\right)}$$

Here the μ and q have been placed below to constitute what is called the reluctance, thus giving as the elements of the formula:

Magneto-motive force = 4π n c

$$\text{Reluctance} = \frac{\text{l}}{\mu \text{ q}}$$

The 10 is there to reduce amperes into absolute units of current which are equal to 10 amperes. If 10 amperes were employed in the coil only 1 absolute unit of current would appear in the formula. The reluctance consists of the dimensions l and q and the permeability μ. If the reluctance becomes less, the lines of force will increase with the magneto-motive force remaining the same. If the reluctance increases, the lines of force diminish if the magneto-motive force remains the same. If the formula for the reluctance is examined it will be found that the reluctance can only be increased by increasing l or the length of the magnetic circuit or decreasing μ or q the permeability and cross-section of the circuit. On the other hand, the formula given as below shows that a great magnetic reluctance can be compensated for by increasing the magneto-motive force :



EFFECT OF REDUCED RELUCTANCE.

$$\text{Lines of force} = \frac{12.57 \times \text{turns} \times \text{amperes} \times \text{permeability} \times \text{cross-section}}{10 \times \text{length of magnetic circuit}}$$

$$= \frac{1.257 \times \text{ampere turns}}{\text{reluctance.}}$$

This simple formula shows that the lines of force produced by a given magneto-motive force will increase or decrease according to the reluctance. In a given coil in which various bars of iron and steel are inserted of equal size, the lines of force produced in each case with a constant current in the coil will depend upon the respective reluctances of the bars.

THE CONICAL WIND MOTOR.*

BY DR. ALFRED GRADENWITZ.

The Danish Government has for a number of years paid much attention to the problem of utilizing the power of wind, and Prof. La Cour has been entrusted with the conduct of systematic experiments in that direction in an experimental mill built expressly for the purpose, in the neighborhood of the town of Askov. Now, some years ago, Mr. Sorensen, a mill engineer, submitted to the Danish professor a wooden wind motor of his own construction, which had shown quite a surprising performance, as, four of the 10 sails of the motor having been broken by a storm, the mill, far from being damaged, worked more satisfactorily than before. This fact showed that the ancient principle, according to which the amount of power gained would be the higher the greater the surface, was false, and further experiments by Prof. La Cour go to bear out this conclusion.

Mr. Sorensen, with the aid of the experience thus gained, improved his motor, and eventually supplied the experimental mill with some wind motor models of a conical shape, having six wings with their points bent forward, the surface area, inclination of wing points and inclination of the wheel shaft being determined according to certain principles. Two types were subsequently tested jointly with eight other wind motors of all the current patterns, including motors with wings both narrow and broad, hollow and level, more or less numerous, and of varying inclination, but all of which had the same diameter as the conical wind motors. The results of some of these comparative tests are shown below, and the shapes of some of the motors are also indicated:

	Fig. 1. Ventotrat.	Fig. 2. Wind-rose.	Fig. 3. Sorensen's old motor	Fig. 4. Conical wind motor.
Area. sq. cm.........	7,440	2,976	1,116	1,188
Output, kgm. sec.	1.59	1.77	1.81	2.34

It is hence inferred that conical wind

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*From the "Electrical Review," London.

motors will give an output nearly 50 per cent. higher than a ventotrat, which is seven times greater, 33⅓ per cent. higher than a wind-rose of 2.8 times greater surface, and 29 per cent. higher than the original Sorensen motor, which was only 7 per cent. smaller. This extraordinary power of conical wind motors may thus be accounted for: The main force of the wind will be applied to the paddle-shaped extremities, the parts most effective in producing torque; while, on the other hand, the wind will be allowed to pass between the wings, thus carrying along the air behind the latter and reducing the back pressure.

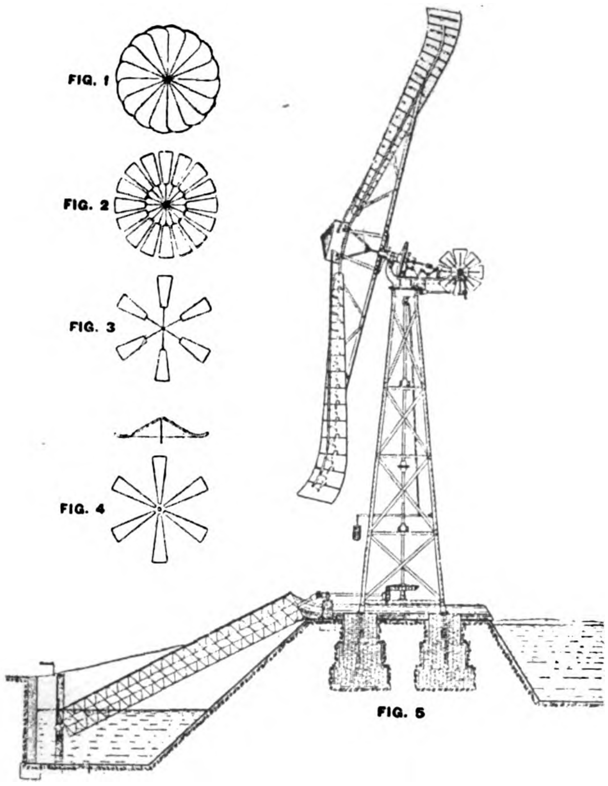

Fig. 5.—Waterworks, with 15 hp. Conical Wind Motor.

That the wind acts on a perforated surface with a power much greater than in the case of an equal surface closed throughout, is borne out by the following experiment: Two plank fences of the same thickness and height, one of which had intervals between the planks, while the other was compact, were submitted to the action of the wind, when the open fence was thrown down, though the compact fence obviously opposed the greater surface to the wind. A further fact known in this connection is that perforated sails will work more satisfactorily than those free from any holes, and this has been utilized in a recent Italian invention.

A further feature of conical motors is their safety against storms. Conical forms are mechanically strong, and the conical shape allows of a far more efficient construction, mechanically; moreover, the area exposed to sudden blasts is quite immaterial in the case of conical wind motors. In the state of rest, the motor is left with the sections wholly opened, as in Fig. 7.

Another feature, i. e., the automatic regulation of the motor, will prove of the highest importance. This regulation is effected by the swivelling boards of the wings being opened by their centrifugal force, when the speed of rotation exceeds a prearranged amount, thus allowing the surplus wind to pass through. As soon as the wind slackens down, the motor rotates at a slower rate, the centrifugal force of the boards will no longer keep them open, and a counterweight draws them together automatically. The regulation according to the direction of the wind, i. e., the steering of the motor, also takes place automatically. In smaller types (up to 6 hp.) this is done wholly by means of a weather flag, which, being thrown by the wind into its direction, will at any time turn the motor towards the wind. For the larger types of motor a wind-rose is used instead, adjusting the wing wheel to the wind by means of worm gearing. Motors intermediate between 6 and 15 hp. may be fitted either with a flag or with a wind-rose.

Apart from the above steering flag, which is made of wood, the conical wind motor consists wholly of iron and steel, even the wind-rose being made of iron.

Conical wind motors are in many cases used in the place of a steam engine. Pumps, wood and iron-working shops and agricultural and milling plants may be operated by these wind motors, which do not require any appreciable amount of supervision; they may also be used for generating electricity. For the latter purpose, the firm of Theodor Reuter & Schumann, of Kiel, Germany, who are the manufacturers of the motors, have designed a very simple apparatus for regulating the speed of the gearing driven from the wind motor with absolute accuracy, as required by a dynamo. Another device enables a wind motor and a steam engine to work jointly on the same transmission, when the wind motor serves to relieve the steam engine, thus securing a considerable saving of coal. In the event of the intensity of the wind decreasing so that the wind motor cannot keep up to the speed of the steam engine, another device will throw it out automatically

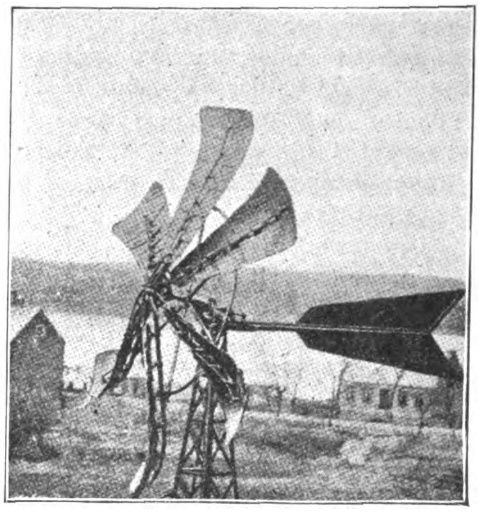

Fig. 6.—Conical Wind Motor, with Wings Closed.

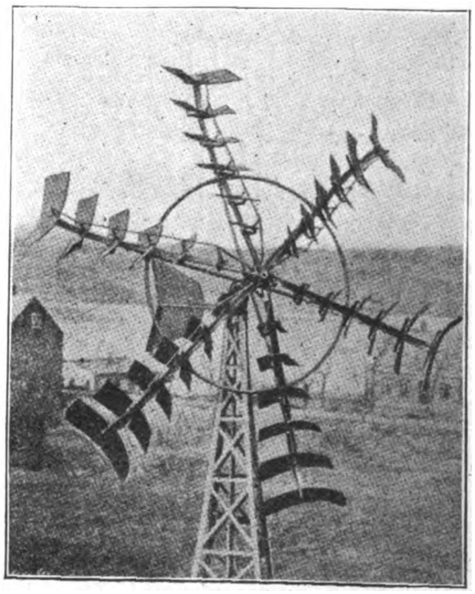

Fig. 7.—Conical Wind Motor, with Wings Open.

during the time of low wind intensity; the steam engine never has to turn the wind motor round.

FOG-DISPELLING APPARATUS.*

Sir Oliver J. Lodge has been granted a patent in England (No. 24,305 of 1903), entitled, "Improvements in means for the production of continuous high potential electrical discharges applicable for the deposition of dust, fume, smoke, fog and mist, for the production of rain and for other purposes," of which the following is an abstract:

The property of the electric discharge of causing the coalescent deposit of matters suspended in a gaseous medium has not come into practical use on account of the difficulties attendant on the use of the statical electrical apparatus, this class of apparatus being too delicate and easily upset for use on an extensive scale. Sir Oliver Lodge's invention consists in a combination of high potential rectifiers, arranged in quadrilateral groups of four or multiples of four in such a way that instead of the reverse pulses of the alternating-current supply being suppressed or non-existent as at present they are redressed to form the positive and negative discharging streams required for the deposit purposes.

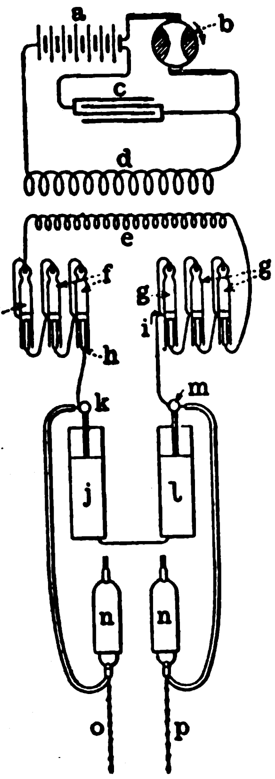

FIG. 1.

Referring to the accompanying drawings: Fig. 1 is a diagrammatic view showing one method of carrying the invention into effect; Fig. 2 shows diagrammatically another method in which an alternating-current dynamo is used; Fig. 3 is a view of a rectifier suitable for use in carrying out the invention, while Figs. 4 and 5 show some of the means of insulation which may be employed.

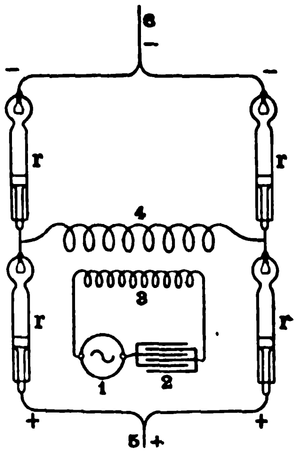

FIG. 2.

In the arrangement shown in Fig. 1, is a battery in circuit with an intermitter, b. and the primary d, of a large Rhumkorff induction coil; a condenser, c, may be placed in placed in parallel with the intermitter b. The secondary e of the Rhumkorff coil is connected through two series of high potential rectifiers, f g, preferably of the form hereinafter described in the terminals k m, of the insulated coatings of a pair of Leyden jars, whose outer coatings, j l, are in electrical connection. To the terminals k m are also attached the leads for discharging wires, o p, which are supported by insulators, n. A dynamo may be employed in place of the battery. The leads or discharging wires must be well insulated (see Figs. 4 and 5). The discharges may be points, flames, or other means whereby a free discharge can be obtained; parallel rows of barbed wire or of barbed wire fencing or other metallic areas may be used, one of which areas may be insulated while the other is earthed, or both may be insulated and placed facing each other beyond sparking distance in the place where the discharge is wanted. When the apparatus is used for the removal of smoke or the like, it is preferable to insulate both dischargers; when the electrification of clouds is the object, one set of dischargers would usually be earthed, and the other set arranged so as to be discharged skywards by well-insulated conductors.

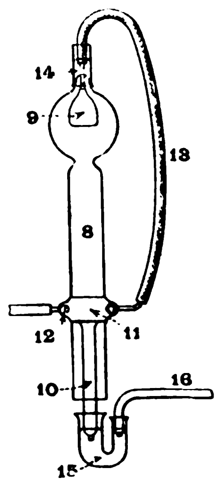

FIG. 3.

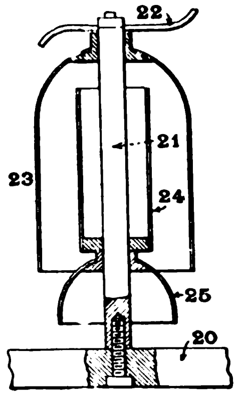

FIG. 4.

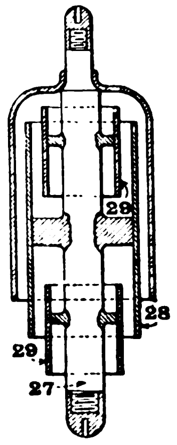

FIG. 5.

In the operation of the apparatus the current generated in the battery or dynamo is interrupted by the intermitter and induces intermittent pulses of violently high potential in the secondary coil of the Rhumkorff coil; these pulses are transmitted through the rectifiers, positive pulses through the series f and negative pulses through the series g, to the insulated coats of the two Leyden jars. The object of each series of rectifiers is to transmit a current easily in one direction and to strongly oppose a passage of current in the opposite direction; by this means the intermittent supply from the induction coil is enabled to maintain the jar or jars steadily charged. The higher the potential desired the more numerous are the rectifiers required in each series, and it has been found that three in each series is a convenient number to use where it is required to keep up a practically continuous discharge, between the dischargers, at a potential of about a quarter of a million volts.

Fig. 2 shows an arrangement in which the source of current is an alternating current dynamo; the dynamo 1 is placed in circuit with a condenser, 2, and the primary, 3, of an alternating current transformer which may, in this case, have a closed magnetic circuit. The high potential rectifiers, r, arranged in a quadrilateral, are combined in four groups, each of which contains one or more rectifiers in series, the number depending on the potential required. Two of the groups of rectifiers similarly directed are connected between the terminals of the secondary coil, 4, and the positive discharging means, 5, and the other two, both directed in the opposite direction, are connected between the terminals of the coil 4 and the negative discharging means, 6. In this arrangement an alternating current dynamo may be used, having an excessively high frequency, say, 3,000 to 4,000 alternations per second, or the alternating discharge of condensers such as Leyden jars may be employed.

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*From the "Electrician," London.

In this case, as in the arrangement shown in Fig. 1, Leyden jars may be connected between the rectifiers and discharging means thereby obtaining a more continuous discharge.

The rectifier shown in Fig. 3 is similar to the Cooper-Hewitt mercury vapor lamps, and is formed from thick glass tube, 8, having an iron anode, 9, at the top and provided at the bottom with a mercury-pool cathode, 10, surrounded by an outside metallic band, 11; the positive terminal 12 is formed on this band which is connected to the anode, 9, by an insulated wire, 13, the contact being made by placing the end of the wire 13 in a vessel, 14, containing mercury formed at the top of the tube 8. A U-tube 15 containing mercury is placed so that the contact leading from the mercury pool is under the surface of the mercury in the U-tube as is also the end of the wire 16 leading from the cathode. The object of the mercury contacts 14 and 15 is to avoid the loss which would otherwise occur at the exposed points on the conductors, when used to convey electricity at the high potential necessary. In some cases the rectifiers may be submerged in oil in order to lessen the liability to loss and spitting off, but this is not usually found to be necessary.

In Fig. 4 the conductor 22 is supported on an ebonite or glass or earthenware rod or other suitable insulator, 21, from a supporting beam, 20; the rod is protected by two umbrella-shaped inverted covers 23 and 25, and a cylindrical vessel 24 open at the top, all of which are constructed of ebonite, earthenware, glass, mica or other suitable material. Fig. 5 shows a modification in which the conductor is suspended from a rod, 27, protected by cylindrical vessels, 28, 29, all being constructed of suitable insulating material.

The apparatus described may also be used for causing the deposit of lead fume in the manufacture of white lead by furnace processes or for depositing valuable factory dust.

The principal claims are:

(1) The method of causing small particles to coalesce into larger ones by the use of a high potential discharge, the supply of electricity being obtained from a dynamo or battery, or from the alternating discharge of condensers. (2) The method of causing small particles to coalesce into larger ones by the use of a high potential discharge obtained by the use of high potential mercury rectifiers and a high potential intermittent or alternating electric current. (3) The method of producing a continuous high potential discharge of electricity in one direction by the use of high potential mercury rectifiers so arranged as to transmit pulses always in one direction and so to charge and keep charged condensers which are connected to the discharging means, substantially as described.

HIGH FREQUENCY ALTERNATOR.

(From our London Correspondent.)

Mr. W. Duddell, of oscillograph fame, gave a description and demonstration of a high frequency alternator which he constructed four years ago for some experiments on the resistance of the electric arc before a recent meeting of the London Physical Society. With this alternator, which consists of an inductor built up out of ferrotype plate having V-shaped notches cut in its edge, so as to have flat-topped teeth, Mr. Duddell obtained frequencies up to 120,000 cycles per second.

Surrounding the inductor is a laminated ring having two inwardly projecting poles, the clearance between these and the teeth of the inductor, which formed the air-gap, being less than 0.1 mm. The ring is wound so that a direct current flowing round the winding tends to produce lines of force from one pole to the other through the inductor. The number of lines of force varies from a maximum when the teeth of the inductor are opposite the poles, to a minimum when the poles are in front of the spaces. This variation in the total number of lines of force produces alternating EMF's. in any winding either on the pole pieces or on the ring itself, the movement of the inductor through the distance between two consecutive teeth producing one complete period. One winding on the ring could serve to carry both the direct field current which magnetizes the ring and the alternating current produced. In practice, owing to the great importance of any self-induction in the alternating current circuit, it was found advisable at high frequencies to use separate windings for the two currents. At the highest frequencies the best results were obtained with coils having a few turns of wire fixed right on the tips of the poles. The alternator is driven by means of a figure-of-8 belt drive from two phosphor bronze disks. Each of these disks is belted to a double-grooved pulley fixed on the shaft of a direct current driving motor. With this method of drive the inductor was run for several months at speeds between 30,000 and 40,000 revolutions per minute, and the spindle of the inductor alone could be easily run at 60,000 revolutions per minute.

Using inductors having 30, 60, 90 and 204 teeth, the author obtains small alternating currents having frequencies from a few hundred periods per second up to 120,000 cycles per second. An illustration will perhaps convey some idea of how high a frequency of 120,000 cycles per second really is. In plotting curves for ordinary frequencies of 50 to 100 cycles per second, a scale often adopted is 10 inches for 100 cycles. If it were attempted to plot a curve up to 120,000 cycles per second to this scale, the curve paper would require to be 120,000 inches, or nearly one-fifth of a mile long. Many difficulties were encountered with the centrifugal forces on the driving-belt, and the author finally obtained the best results with a spliced cotton cord.

Prof. J. A. Fleming, in the course of the discussion which followed, expressed surprise that Duddell had been able to reach so high a frequency; it spoke highly of the excellent means employed. The difficulty with most high frequency alternators was the magnetic leakage. So far as wireless telegraphy was concerned the professor remarked that it was no use to speak of a machine even if it gave the frequency mentioned, corresponding to a wave of 1½ miles in length, if its output were only a few watts. If it were 150 hp. it might be different.

SEWAGE PURIFICATION BY ELECTRICITY.

Is electricity to include in the list of its marvelous achievements the solution of the great problem of sewage purification? A great deal has been heard, especially since the appointment of the Royal Commission on Sewage Disposal, says an English paper, as to the bacteriological treatment of sewage, and electrical methods have given results so encouraging that no surprise will be felt that it is an electrical process which has produced what seems to be a perfect purifier, cleanser and sterilizer. The opinion expressed by a number of sanitary scientists and others, less skilled, perhaps, although not less interested in the problem, who visited the Guildford Sewage Works the other day, was that the solution which is the agent employed in the oxychloride sewage process is a potent deodorant and germicide, adaptable with equal success for sewage purification, for household disinfection, and for general cleansing and bleaching purposes.

The process by which this purifying agent is produced is simple, and the necessary plant inexpensive. It consists in the electrical decomposition of salt and water, or, where easily obtainable, sea water in a specially designed electrolyzer having a large superficial area of electrical surface, which permits of the use of a large volume of current at a very low voltage, thus securing economy of operation. The solution thus obtained is added to the effluent in quantities varying according to its nature and the water into which it has to be discharged.

To demonstrate the commercial application of the process to sewage purification, Dr. Rideal, the well known expert, has made a series of experiments, extending over several months, in specially constructed tanks at the Guildford Sewage Works, the authorities having given every facility for the most thorough tests. To the visitors Dr. Rideal explained that at Guildford every kind of effluent could be dealt with, and tests had been carried out with raw sewage septic tank effluents and those from primary, secondary, and tertiary filters, and the efficiency of the solution in removing putrefactive organisms, the organisms which are comparable in origin and vitality with those which cause typhoid fever and cholera, and organic matter in solution had been demonstrated. To the public the interest lies not in the process, but in its results, and these suggest that in the treatment of raw sewage, or that which had undergone preliminary treatment in a septic tank, the solution has an effect, immediate and potent. To produce a purity from bacteria equal to or better than that generally allowed for drinking water was found not to be a difficult matter. With a primary effluent, 7½ gallons of oxychloride per 1,000 gallons of effluent reduced the bacillus coli—present in all sewages, and allied to the typhoid bacillus—and the enteritis spores from over 100,000 and 100 respectively, so that none could be found in one cubic centimeter in 1 hour 20 minutes after treatment. In raw sewage, 18½ gallons per 1,000 reduced the coli from over 1,000,000, so that none were found in one cubic centimeter, and the enteritis spores from over 1,000 to less than ten in 5 hours, and the total number of organisms from 23,200,000 to 540.

The Annual Scientists' Meeting.

Over 1,500 scientists of the United States were in attendance at the annual meeting of the American Association for the Advancement of Science and of the American Physical Society held in Philadelphia, during "Convocation Week," from December 26 to January 2. The presiding officers were W. F. Magie, the vice-president of Section B, and Prof. Arthur C. Webster, president of the American Physical Society.

Hon. Carroll D. Wright retired from the presidency of the association and was succeeded by Prof. W. G. Farlow of Harvard.

Among the many papers read were the following:

"Experimental Study of the Use of Weston Instruments for Ballistic Magnetic Testing," Alb. F. Ganz, Stevens Institute of Technology,

"Explanation and Demonstration of the Poulsen Telegraphone," Z. B. Babbitt, New York City.

"Electric Double Refraction in Liquids Under Low Electric Stress and also at at the Boiling Point," D. B. Brace, G. W. Elmen and L. B. Morse, University of Nebraska.

"The Electromagnetic Theory and the Velocity of Light," Henry T. Eddy, University of Minnesota.

"The Distribution of Energy in the Visible Spectrum," Edward L. Nichols, Cornell University.

"Objective Method for Showing Distribution of Nuclei Produced by X-rays or other Radiation," C. Barus, Brown University.

"Experiments on Resonance in Wireless Telegraph Circuits," G. W. Pierce, Harvard University.

"The Ratio of Electrical to Gravitational Forces," Bergen Davis, Columbia University.

"A Measurement of the Thomson Thermo-electric Effect in Iron," Edwin H. Hall, Harvard University.

"A Contribution to the Theory of Thermo-electromotive Force," C. B. Thwing, Syracuse University.

"New Phenomena of Fluorescence," Harry W. Morse, Harvard University.

"The Tuning of Thermo-electric Receivers for Electric Waves," A. D. Cole, Ohio State University.

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The Norwegian steamer Atlas reports that on her trip up the coast from the West Indies the electric beam that is thrown skyward from the deck of the Diamond Shoals Lightship was visible for 24 miles. The longest distance previously reported at which the beam was seen is 21 miles.

The Paris Automobile Exhibition.

On Friday, December 2, the great motor exhibition at the Grand Palais in the Champs Elysees was opened by President Loubet. The exhibition is of a representative character, but there are no striking innovations. The exhibition practically marks the disappearance of the tubular frame, the uninclosed type of radiator, and the atmospheric inlet valve. Even Renault and the De Dion firm, have come substantially into line in this respect. Panhard still retains the wood and flitch plate frame, and C.G.V. the square section wood-filled tube, but with these exceptions, every French maker has adopted the "chassis embouti," first introduced by the makers of the Mercedes. The conservative Panhard, however, still adheres to the atmospheric inlet valve on the 7 hp. and 10 hp. cars, and De Dion retains it on all models, but everywhere else the mechanically operated valve reigns supreme. Radiators are invariably inclosed, and generally cooled by one, or sometimes two fans. There is a distinct tendency to place the fan in the flywheel, and where the belt driven fan is retained, provision is generally made by means of a spring for keeping the belt at a constant tension.

Clutches are of many varieties, as heretofore, but the well-tried leather-covered cone type seems at least to be holding its own in popularity. The high-tension and low-tension systems of magnets are both increasing in favor, to the almost entire extinction of the old coil and accumulator method of ignition. In one or two cases the ignition lever has entirely disappeared. There is a slight tendency to place less reliance on the engine governor, and in many cases the depression of the clutch pedal throttles the motor; and in all the Mors cars the governor has been abolished altogether, thus following the established Wolseley practice. The methods of lubrication and filling petrol tanks show considerable improvement. Prominent among the British exhibits is that of the Hozier Engineering Company, which includes a 10-12 hp. two-cylinder car, fitted with an Astor engine built into a long frame. This car is an improved successor of that which the company successfully introduced last season.—"Electrical Engineer," London.

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Major Squier's Wireless Discovery.

A press dispatch from San Francisco, January 1, says that a discovery of the greatest importance to wireless telegraphy and to the electrical and scientific world in general has just been announced here by Major George O. Squier, U. S.A., chief signal officer of the Department of California. In a report to the War Department, he says that ordinary trees are conductors and transmitters of wireless telegraph and kindred magnetic waves, and in proof of this he has received and sent wireless messages by merely connecting his apparatus to two nails driven in the trunk of a tree.

Major Squier drove two nails in a tree on the lawn of General MacArthur's quarters at Fort Mason, and by attaching a simple field wireless telegraph receiver to those nails, read all the messages that were passing between the naval wireless telegraph stations at Goat Island and Mare Island Navy Yards, many miles away.

10,000 hp. Dynamos Set in Motion.

The Canadian Niagara Falls Power Company, the ally of the American Niagara Falls Power Company, successfully set in motion on Monday two of their 10,000 hp. turbines and dynamos before the officers of the power company and distinguished guests.

These are the largest machines in the world, and their operation marks an electrical epoch. Francis Lynde Stetson, of New York, and President W. H. Beatty, of the Canadian Company, turned on the power.

Preparing the Question Box.

Mr. Homer E. Niesz, editor of the Question Box for the Denver-Colorado Springs meeting of the National Electric Light Association, has sent out over 7,000 letters to companies and individuals in the electrical field asking them to submit questions to be grouped under the following headings: A, Buildings; B, Water Wheels, Water Power, etc.; C, Feed Water, Heaters and Pumps; D, Fuel; E, Boilers and Mechanical Stokers; F, Forced Draft, Blowers, Stacks; G, Piping, Condensers, etc.; H, Engines; I, Turbines; J, District Heating; K, Generators and Exciters; L, Storage Batteries and Boosters; M, Switchboards, Instruments and Station Wiring; N, Belts and Shafting; O, Oil and Waste; P, Overhead Lines; Q, Underground Lines; R, Transformers; S, Lamps—Arc, Incandescent, etc; T, Heating, Battery Charging and Power; U, Meters; V, Advertising; W, Contracts and Rates; X, Accounting and Statistics; Y, Management; Z, Miscellaneous.

Mr. Niesz not only desires questions from those seeking information, but he appeals to the missionary spirit in those who have solved difficulties for themselves, and asks them to send questions to which they have found solutions together with the replies, for the benefit of others.

There is practically no limit to the benefits to be gained through this interchange of knowledge, and, if it were understood as it should be by central station companies not already members of the National Electric Light Association, they would lose no time in taking membership.

Proposals Invited.

The Navy Department, through the Bureau of Yards and Docks, is inviting sealed proposals until January 21, for furnishing a 20-panel switchboard for the Washington Navy Yard. Plans and specifications will be furnished by the commandant of the yard.

The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until January 24 for the installation of an electric lighting system, etc., at the U. S. Naval Training Station at Newport, R. I. Blank proposals will be furnished upon application to the bureau or to the navy pay office in Newport. On the same date the bureau will open bids for the installation of an electric lighting system, exterior underground conduit and cable, and fire alarm, call bell and telephone systems in and near the barracks building now under construction at the training station at Newport.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED DEC 27, 1904.

Electric Railways and Appliances

778,256. Electric Railway. Joseph dela Mar, New York City, assignor of one-half to Mathias A. Lazareff, same place. Filed March 8, 1904.

778,356. Railway-Signal. Frank L. Fuller and Charles S. Banghart, New York City. Filed March 21, 1904.

778,376. Trolley Harp and Guard. Stephen G. Reynolds, Easton, Pa., assignor of one-half to Nathan Freeman, same place. Filed June 29, 1903.

778,418 Railway Block-Signal System. Rector E. Land, Mount Washington, Mo. Filed April 25, 1904.

778,520. Trolley, John S. Weckman, Carnegie, Pa. Filed Sept. 22, 1904.

778,832. Electric Traction. Henry B. Greenwood, Buenos Ayres, Argentina. Filed July 16, 1904.

Electric Lights and Appliances.

778,280-281. Incandescent-Lamp Socket. Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York City. Filed Nov. 24 and Dec. 11, 1902.

778.383. Incandescent-Electric-Light Socket. Luttrell H. Stuart, Chicago, Ill., assignor of one-half to Necter-Rousseau, Sr., same place. Filed Aug. 14, 1903.

778,489. Electric-Arc Lamp. Albert W. Hendricks, Pittsburg, Pa. Filed March 30, 1904.

778,602. Electric Lamp and Shade-Holder. Louis H. Perkins, Meriden, Conn., assignor to Edward Miller & Co., same place. Filed May 18, 1904.

778,618. Means for Supporting Electric Lamps and Energizing and Lighting Same. William H. Wilkinson, Boston, Mass. Filed April 29, 1904.

Electrical Machinery and Apparatus.

778,222. Automatic Current-Regulator for Electric Motors. Alexander Churchward, New York City, assignor to the General Electric Company. Filed July 16, 1903.

778,238. Electric Brake. Edwin R. Gill, New York City, assignor to the Invention Developing Company Fil 900

778.221. Apparatus for Producing High Vacuums. William R. Burrows, Newark, N. J., assignor to the General Electric Company Filed April 8, 1901.

778.242. Electrical Controlling Apparatus. George H. Hill, Glenridge, N. J., assignor to the Sprague Electric Company. Filed June 27, 1902.

778.333. Electric-Current Governor. Walter J. Richards, Milwaukee, Wis. Filed April 11, 1903.

778,400. Electric Motor. James H Bryson, St. Louis, Mo., assignor to the Wagner Electric Manufacturing Company, same place. Filed April 21, 1904.

778,531. Electric Fuse Switch-Box. Louis W. Downes, Providence, R. I., assignor to the D. & W. Fuse Company, same place. Filed May 20, 1904.

778,549. Apparatus for Transmitting Power at Varying Speeds. Walter F. Rice, Fitchburg, Mass. Filed July 20, 1903.

778.575. Quick-Break High-Tension Electric Switch. Henry K. Gardner, Providence, R. I. Filed Dec. 21, 1903.

778,681. Electrical Connector. Hubert Krantz and Ernest W. Muller, Brooklyn, N. Y., assignors to the H. Krantz Manufacturing Company, same place. Filed March 15 1904.

778,798. Frame for Electrical Machines. Francis A. Pocock, Lansdowne, Pa., assignor of three-eighths to Edward W. Patterson, Philadelphia, Pa. Filed Oct. 17, 1903.

778,825. System of Motor Control. George H. Hill, Schenectady, N. Y., assignor to the Sprague Electric Company. Original application filed June 27, 1902. Divided and this application filed July 25, 1904

Telephones and Telephone Apparatus

778,322. Telephone-Circuit John W. H. Maclagan Park Ridge, N. J. Filed June 23, 1900.

778,409. Telephone Apparatus. Oscar M. Fryman, St. Paul, Minn. Filed April 20, 1903.

778,448. Tablet-Holder for Telephones. John W. Currier, North Tro , Vt. Filed Aug. 9, 1904.

778,569. Supervisory Apparatus for Telephone Systems. William W. Dean, Chicago, Ill., assignor to the Western Electric Company. Filed July 7, 1902.

778,599. Telephone-Exchange Switchboard Apparatus. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company. Filed Feb. 1, 1902.

Miscellaneous.

778,269. Process of Electric Welding. Adolf F. Rietzel, Lynn, Mass., assignor to the Thomson Electric Welding Company, same place. Original application filed Oct. 15, 1903. Divided and this application filed Feb. 6, 1904.

778,275. Adjustable Bolometer Detector for Electro-Magnetic Waves. Charles K. Salisbury, Lincoln Township, Blackhawk County, Ia. Filed April 22 1904.

778 286. Manipulation of Refractory Material. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed Aug 28, 1902.

778,297. Composite System Duplex-Telegraph Circuits. William E Athearn, New York City, assignor to the American Telephone & Telegraph Company. Filed May 13, 1904.

778,305 Coin Controlled Circuit Making and Breaking Apparatus for Phonographs. Arthur W. Cole, West Hoboken, N. J. Filed April 26, 1904.

778,308. Therapeutic Electrode. George H. Day and Frank J. Stein, Louisville, Ky. Filed July 13, 1904.

778,414. Electric Cigar Lighter. William P. Carstarphen, Jr., Denver, Col. Filed April 4, 1904.

778,560. Supporting and Shifting Battery for Automobiles Allan R. Whiting Orange, N. J. Filed Sept. 19, 1903

778,621. Electromechanical Vibratory Massage Apparatus. Charles Adams-Randall New York City, assignor to the Randall & Carey Vibral-Massage Machine Company. Filed Jan. 9, 1904.

778,653. Electric Battery. Arnold Gabrielson, Milwaukee, Wis., assignor of one-fourth to Ole H. Lee, same place. Filed July 21, 1904.

778,693. Electrical Outlet-Box. Ernest W. Muller, Brooklyn, N. Y., assignor to Hubert Krantz, sam place. Filed April 23, 1903.

778,714. Electric Compensator. Edmund O. Schwe tz Chicago, Ill., assignor of one-half John J. Schay same place Filed Dec. 14, 1903.

778,771. Electromechanical Apparatus for Vibratory Massage. Charles Adams-Randall, New York City, assignor to the Randall & Carey Vibral-Massage Machine Company. Filed Feb. 9, 1 04.

778,770. Thermostat. Albert Goldstein, New York City, and Horace E. Rice, Philadelphia Pa Filed May 23, 1903.

Design.

37,278. Incandescent Lamp. Albert H. lling, New York City, assignor t he Talmo ineering Com

THE TELEPHONE WORLD.

Over 100 Companies Now Operating in South Dakota.

That the telephone is well patronized by the people of South Dakota is shown by the increase in numbers of companies, year by year, as reported to the State Auditor. In 1900 there were 35 companies operating in the State with 2,908 miles of line. The 1904 report of the auditor shows 106 companies in the State, with 9,782 miles of line.

The increase has been greatest the past two years, as only 35 companies reported in 1900, with 37 in 1901, 47 in 1902, 73 in 1903 and 106 in 1904.

Considerable complaint has been made in regard to the excessive telephone rates charged by the Cumberland Company in New Orleans, La. The rate charged the city represents an increase from $24 to $126 for the same period. This is 525 per cent. increase in one year. An effort was made to enter into a contract with the city at the rate of $80 per annum, the ordinance passing the council, but being vetoed by Mayor Mehle, it failed.

Announcement was lately made in Chillicothe, Mo., of the sale of a half interest in the Chillicothe telephone exchange, owned by Dr. Arthur W. McArthur, of Kansas City, to W. H. Ellett, president of the People's Savings Bank of Chillicothe. The reported consideration was $14,000 for the half interest. W. B. Leach owns the other half. Mr. Ellett denies the report that he is acting as agent for the Bell Company in the purchase.

The business men of Apache, together with a large number of farmers between Apache and Anadarko, Okla., have reorganized a stock company to build a telephone line from Apache to Anadarko. The stock has been subscribed, and work will begin at once. O. W. Rogers is president, Arthur Dyer secretary, and M. Hester treasurer of the company.

The net output of the American Telephone & Telegraph Company for November was 63,988 instruments, a decrease of 678, as compared with the same month last year. The total number of instruments outstanding on November 30 was 4,408,177, as against 3,730,248 at the same date last year.

Eight Cambridge, Minn., citizens have incorporated a telephone company which is to have headquarters in that town, and be known as the Cambridge Telephone Company. The capital stock is placed at $50,000, and lines will be maintained in Isanti and surrounding counties.

The Auburn, Mo., Telephone Company has been incorporated with a capital stock of $35,000, by B. H. Ramsey, E. R. Conklin and F. W. Kelly.

The Riley County, Kan., Farmers' Telephone Company, recently incorporated with a capital of $2,600, has begun the construction of a rural line.

The Bergen County N. J., Telephone Company, capitalized at $5,000, has been incorporated by John T. Trumbull, Edward H. Hoos and Spencer Weart.

New England Company Reduces Telephone Rates.

The reduction in telephone rates by the New England Telephone & Telegraph Company in Boston, where it has no opposition, has raised the question as to the purpose and expediency of this action.

An official of the company says: "The main reason for reducing the telephone rate from 10 cents to 5 cents in the exchanges of Boston proper was to popularize the telephone. With this reduction it is our expectation to place an increased number of telephones in the smaller mercantile houses, the nickel-in-the-slot machine being the form of telephone to be generally installed.

"As the area affected by the reduction includes a large residential section, especially the Back Bay, it is anticipated many additional home telephones will be installed.

"For a short time the company will, of course, suffer a loss in revenue by the reduction but this loss will be far more than made up in a short time by the increased use of the telephone."

Telephone Company's Earnings.

The Northwestern Telephone Company of Minneapolis, Minn., has filed a statement with the State Auditor showing gross earnings of $984,834.51 for the year ending November 30, 1904. The company is to pay a 4 per cent. tax on this, which will amount to $29,545.03.

Stearns County, Minn., has another telephone concern known as the Commercial Telephone Company of Belgrade. The capital stock is placed at $50,000, and the following are the interested parties, all of Belgrade: T. J. Anderson, C. Borderding, John F. Chisholm, Alexander Ridgeway, M. J. Mickelson, K. S. Colbiorsen, A. J. Lindquist, C. M. Iverslie, John H. Romness and S. F. Strong

C. C. Haas, a wealthy farmer near Whitewood, S. D., is about to organize a company for the purpose of putting in a telephone line from the Belle Fourche River to Whitewood. He has already constructed two miles of private line. The line will benefit a large number of farmers who live between the river and Whitewood.

About 600 telephones were put out of service by a recent fire in Sioux City, and the Iowa Telephone Company sustains a loss of between $5,000 and $6,000, according to the estimate of Manager E. A. Clark. The cables and wires in the burned district were entirely destroyed.

The first rural telephone line to be put into operation in Herkimer County by the Central New York Telephone Company was lately opened. The line extends from the company's central office in Cohoes to Eatonbush.

The New York & New Jersey Telephone Company has declared a regular quarterly dividend of 1½ per cent., and an extra dividend of 1 per cent. payable January 16, to holders of record January 5.

W. A. Pixley has been appointed auditor of the Nebraska Telephone Company.

Free Toll Service in Richmond, Ind.

Upon the recent completion of its new switchboards, the Home Telephone Company of Richmond, Ind., gave its subscribers free long-distance telephone service over the United States Telephone Company's lines in its Ohio territory. The above territory includes practically all of Ohio and parts of Michigan, Pennsylvania and West Virginia. The company has just installed new and up-to-date toll switchboards and now has has entirely separate apartments for its long-distance business. The boards installed are the latest and best type, and place the company in excellent position to take care of its long-distance business, as neither money nor time was spared in its effort to make its toll system as perfect as possible. Work is now in progress on additional copper toll lines between Richmond and Indianapolis, which will materially improve the service and facilitate prompt handling of toll business going west.

The Utah Independent Telephone Company recently made an official proposition to the business men of Salt Lake City to eventually inaugurate a party-line service. The proposition was made in writing to the committee appointed at the citizens' meeting held some weeks ago. The proposition made by the Independent company is that it will reduce the price of its residence 'phone, individual line, unlimited service, full metallic service, from the present price of $2.50 a month to $2 a month, this price to be maintained until the company shall have 6,000 subscribers connected in Salt Lake City. After that time the subscriber shall have the alternative of continuing this service at $2.50 a month or going on a two-party line with unlimited service at $2 a month.

The State Treasurer of Minnesota has received $11,584.50 from the Twin City Telephone Company. The amount was paid as the 3 per cent. gross earnings tax on the company's earnings in that State. The gross earnings of the Twin City Company, as reported by its officers for the year ending November 30, were $386,150.

The Independent Telephone Company of Salamanca, N. Y., has completed the construction and equipment of three copper circuits to Buffalo via Gowanda. Direct service is thus established to all towns in the vicinity now reached by the Inter-Ocean Company.

The Farmers' Telephone Company of Wills Point, Tex., capitalized at $10,000, has been formed for the purpose of constructing telephone lines in Van Zandt County. The incorporators are J. F. Sallee, A. M. Herrin and John Z. Owens.

The Niagara County Home Telephone Company has made application to the common council of North Tonawanda, N. Y., for a franchise to distribute electricity for lighting, heating and power purposes, It will use its own pole lines for distributing cables.

The Home Telephone Company of Santa Monica, Cal., has been granted permission to place its wires underground.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Benwood, W. Va.—The Ohio Valley Electric Company of this city and McMechen, has been incorporated with a capital of $50,000 to construct and operate an electric light plant, etc.

Calgary, N. W. T.—By a vote of 422 to 46 the people of this place decided in favor of installing a municipal electric lighting plant.

Cayuga, Ind.—The matter of installing a city electric lighting system here was lately discussed, and a committee appointed which will inspect lighting plants in other towns and ascertain the cost.

Clarinda, Ia.—A special city election will be held January 18 to vote on the proposition of granting a franchise to the Lee Electric Light Company to erect an electric lighting plant.

Des Moines, Ia.—The city council has ordered more lights, both gas and electric, arc and incandescent, for the suburban residence district.

East Moline, Ill.—The residents of this city want electric lights in their homes.

Eureka, Cal.—The electric power plant of the Eureka Lighting Company was recently destroyed by fire. The loss is estimated at $30,000.

Gilt Edge, Mont.—M. J. Dignan is figuring on installing an electric light plant here.

Jacksonville, Tex.—F. K. Nance has purchased the plant of the Jacksonville Electric Company and will expend $5,000 in improvements.

Lebanon, Ind.—A franchise has been granted to the Citizens' Electric Light & Ice Company to light the streets and for commercial lighting. E. D. Connor, city clerk.

Little Rock, Ark.—A number of the business men of this city and St. Louis recently purchased the electric light plant of Camden, Ark.

Mansfield, Mass.—At a special town meeting it was voted to appropriate $1,900 for increase in the commercial departmnet of the electric lighting system, and light the town hall and library by electricity.

Marshalltown, Ia.—The Business Men's Association has under consideration the matter of installing an electric lighting plant.

Mattoon, Ill.—The city council will soon be asked for a franchise for another electric light and power plant.

Meridian, Miss.—C. H. Dabbs, E. Cahn and others have applied for a franchise to establish a plant for furnishing gas, electric lights and steam heat.

Mineral Wells, Tex.—The Mineral Wells Electric Light, Power & Heating Company has been incorporated with a capital of $50,000 by D. G. Galbraith and others.

Moline, Ill.—A reduction from 5 to 20 per cent. on present figures on incandescent lights will be put into effect by the People's Power Company, beginning February 1.

Montgomery, Ala.—D. P. West will erect an ice and electric light plant at the corner of Bibb and Moulton streets.

Moscow, Ida.—The city council has granted the Moscow Electric Light Company a franchise to operate its local plant for 25 years.

Norfolk, Neb.—The council has granted a franchise to the Sugar City Cereal Mills to install an electric light system in this city.

North Attleboro, Mass.—Owing to a demand for electricity for power and lighting, extensive improvements are to be asked for at the annual meeting of the voters in March.

Oshkosh, Wis.—It is stated that the Central Construction Company of this city is about to ask for a franchise to erect an electric lighting plant for commercial purposes.

Pitman Grove, N. J.--The plant of the Pitman, Clayton & Glassboro Electric Light Company was recently sold by the receiver, David C. Watkins, of Woodbury, to M. K. Treichler, of Philadelphia, for $20,000.

Reading, Pa.—An electric light plant is to be installed in the new Reading car shops at Newberry Junction.

Richmond, Va.—It is reported that E. W. Trafford has been engaged to prepare plans for an electric lighting plant. W. H. Thompson, city electrician.

Royse City, Tex.—It is reported that J. E. Pynter & Son, of Adairville, Ky., and others are interested in the erection of a flour mill and an electric lighting plant. The company will be organized as the Royse Milling & Light Company.

San Diego, Cal.—The electric lighting plant here was lately damaged by an accident to the engine.

Siloam Springs, Ark.—The Siloam Springs Railroad, Power & Light Company, recently incorporated, will build a railroad and erect an electric light plant for furnishing light and power. Its capital stock is $500,000. D. Zimmerman president.

Toledo. O.—Col. J. C. Bonner, J. C. Hallepleus and others, of this city, are at the head of a company formed to develop water power in New Mexico. The company expects to furnish electric light to Las Vegas, Santa Fe and Albuquerque.

Vidalia, Ga.—The Vidalia Water & Electric Light Company has been incorporated here.

Youngstown, O.—The special committee of the city council will recommend the issue of bonds to the amount of $100,000 to build a municipal electric light plant.

STREET RAILWAYS.

Keokuk, Ia.—The proposed electric railroad from this city to Saint Francisville will be put through soon.

Litchfield, Ill.—It is reported that a traction company is negotiating with the Chicago & Alton for the purchase of the Quincy, Carrollton & St. Louis Railroad, for the purpose of converting it into an electric line.

San Diego, Cal.—President E. S. Babcock, of the San Diego & LaJolla Railroad, announces that the road will be changed from a steam to an electric line and the service quadrupled. The necessary material has been ordered and work will shortly be commenced.

Spokane, Wash.—The Washington Water Power Company proposes to build an electric line to Silver Lake in connection with the Medical Lake system.

St. Paul, O.—A company has been organized to build the Hutchinson & Western Railway. It is proposed to build electric lines through at least four counties.

POWER PLANTS.

Canaan, Conn.--The Berkshire Power Company, which has been organized here with a capital stock of $240,000, will construct a dam and power house on the Housatonic River at North Canaan. Preliminary work has already been commenced and the undertaking will be pushed as rapidly as possible. Plans for the generation of a large volume of electric power to be distributed over a large area have been formulated.

Duluth, Minn.—Messrs. Tucker, Anthony & Co., of Boston, and Charles D. Barney & Co., New York and Philadelphia, make the announcement that they have formed a syndicate to supply the money for the development of the water power in the St. Louis River between this city and West Superior. It is proposed to develop more than 100,000 hp.

Marion, Ind.—The power plant owned by the Pittsburg-Columbia Oil Company was recently destroyed by fire, entailing a loss of $3.000. A new plant will be constructed.

Milwaukee. Wis.—The architect firm of H. C Koch & Co., has filed with the building inspector plans for a new power plant.

Muskegon, Mich.—The Grand Rapids & Muskegon Electric Power Company has been incorporated with a capital of $1,000,000, for the purpose of building dams across the Muskegon River at Big Rapids, to furnish cheap electrical power to this city, Grand Rapids, Big Rapids and small towns in Western Michigan.

Salida, Col.—Plans are practically complete for the erection of a big power plant at Arborville, on the south fork of the Arkansas River, 15 miles north of here. The work is being carried on by the Edison Electric Company of Salida. The enterprise will involve the expenditure of $75,000, and is backed by local capital. The plan is to furnish cheap electric power in this city.

BIDS WANTED.

Alameda, Cal.--The city trustees are in the market for a tandem compound engine and generator, with a capacity of 240 kilowatts, for the municipal light plant to cost $13,000.

Anadarko, Okla.—The council has advertised for bids, to be opened January 9, for the construction of a municipal electric lighting plant to cost about $10,000.

San Antonio, Tex.--Sealed proposals, in triplicate, will be received here and at the office of the quartermaster, Fort Logan H. Roots, Ark., until 11 o'clock A.M., January 30, for the construction of a brick administration building, including installation of plumbing, hot water heating and wiring for electric lighting at Fort Logan H. Roots, according to plans and specifications to be seen at this office and office of quartermaster, Fort Logan H. Roots, Ark. The United States reserves right to reject any or all bids, or any part thereof. Information furnished on application, Envelopes containing proposals should be marked "Proposals for Administration Building at Fort Logan H. Roots, Ark.," and addressed to the undersigned or to the quartermaster, Fort Logan H. Roots, Ark. Robert R. Stevens, chief quartermaster.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 14¾@15c.; Lake 14⅞@15⅛c.; casting, 14½@14¾c.

The annual meeting of the stockholders of the Columbus (O.) Edison Company will be held on January 10.

January interest and dividend disbursements in Boston are estimated at $31,254,787, against $24,053,651 in January, 1904.

The Chicago Edison Company is said to be doing the largest business in its history. The order department is nearly a month behind in new contracts.

In a single day the East Boston tunnel proves its value as a time saver; 32,000 passengers paid fares, the business of the ferries being cut about one-half.

The St. Louis United Railways Company reports for the year ended December 31 (partly estimated) a surplus after charges of $2,332,275, an increase of $634,370.

According to documents placed in Comptroller Grout's possession he says the lighting companies of New York owe the city more than $5,000,000 for the use of conduits.

Electric Company of America (Philadelphia) once sold at $23, the par value being $10 a share. Now its earnings are greater than ever before, but the quotation is only $11.

A Philadelphia dispatch says the net earnings of the Electric Company of America for the fiscal year ended December 31 will not be much over $407,000, or 10 per cent. on the stock.

A New York banking firm has purchased $5,000,000 bonds of the Sandusky & Southern Electric Railway Company, which operates an electric line from Sandusky to Wapakoneta, O.

The Rock Island Battery Company, which proposes to do a general electric business, has been incorporated in New Jersey with a capital stock of $75,000. The incorporators are Louis B. Dailey, B. Stafford Mantz and Joseph M. Mitchell.

John I. Beggs, president of the Milwaukee Railway & Light Company and a director of the North American Company, makes this statement: "The reports that the North American Company intends to buy the street car system of St. Louis is without any foundation."

In the litigation to collect judgments amounting to $1,000,000 against the St. Louis Transit Company, the Circuit Court has decided that the United Railways Company, which absorbed it, is not responsible. The St. Louis Transit Company is now out of existence and has no assets.

The gas commissioners have authorized the Lowell (Mass.) Electric Light Company to issue 500 additional shares of stock at $145 a share to fund the floating debt incurred in making extensions to plant. The last public sale of the company's stock was at $180 a share.

Ladenburg, Thalmann & Co. of New York offer to investors Birmingham Railway, Light & Power Company general mortgage refunding 4½ per cent. gold bonds, due April 1, 1954, at 93½ and interest. As its title indicates, the company serves the city of Birmingham, Ala., with local transit facilities, electric light and power. The total issue of the bonds is $10,000,000, of which $2,208,000 are authorized for immediate issue, $5,022,000 are reserved to retire underlying bonds in the hands of the trustee and $2,770,000 are reserved for future improvements. Since its formation the company has paid 6 per cent. dividends per annum on its preferred stock and dividends on its common stock since January, 1903.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Noon price Jan. 3.
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	165
Metropolitan Street Railway	120
Metropolitan Securities	79
Ninth Avenue	197
Third Avenue	132
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	61
Interborough Rapid Transit	135
New Orleans Railway	164
Public Service Corporation (New Jersey)	2½
Philadelphia.	
Consolidated Traction of New Jersey	77½
Philadelphia Traction	98½
Union Traction	59⅛
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	14
do. do. do. pref.	62
West End Street, com	92½
do. do. do. pref.	113
Chicago.	
City Railway	186
North Chicago	87½
Union Traction, com	9
do. do. pref.	39½
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	17
do. pref.	69½
Electric Boat, com	40
do. do. pref.	70
Electric Lead Reduction	½
Electric Vehicle, com	17
do. do. pref.	23
Westinghouse, com	180½
do. pref.	195
General Electric	186
Boston.	
Edison Electric Illuminating	254
General Electric	186
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	43
do. do. pref.	109
Philadelphia.	
Electric Company of America	10
Electric Storage Battery, com	79
do. do. do. pref.	79
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	146
Western Telephone Company	20
New England Telephone Company	137
New York.	
American Telegraph & Cable Company	93½
Commercial Cable Company	210¼
Mexican Telephone Company	2
New York & New Jersey Telephone Company	158¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93¾
Chicago Telephone Company	44¾
MISCELLANEOUS STOCKS.	
Otis Elevator Company	47
Consolidated Car Heating	64
Standard Underground Cable	200

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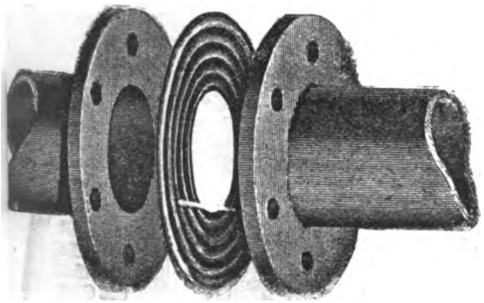

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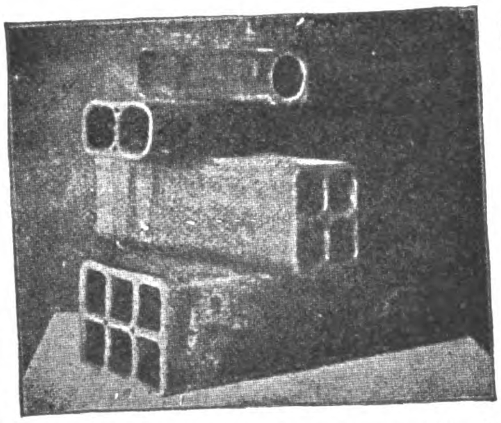

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ELECTRICITY.

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EDITORIAL NOTES.

One Hundred Thousand Volts for Power Lines.

An epoch, which well may be called a triumph, has been reached in the history of electric power transmission. Step by step the rising tide of pressures has risen to stay; and now anticipation has become realization and the lightning in truth has been led through miles of wires on its mission of industrial development.

The students of power transmission problems have been guided by the academic propositions laid down in innumerable text books, and have at times strenuously decried the possibilities which thousands of volts represented to the energetic and enterprising engineer for the moving of large powers from their sources to other distant points.

Many questions are involved in such an undertaking; questions which lie at the very heart of the matter. Efficiency, cost of construction, flexibility of operation, insulation and danger among the most important. It sounds like a simple proposal to transmit 10,000 hp. over 100 miles of line and then to distribute it. Here, again, a dual problem presents itself—the problem of transmission and distribution.

Enormous pressures are now in actual use and the limitations of power transmission are best expressed by the limitations in insulation. There is now a plant at Norris, Montana, consisting of two 1,000 kilowatt low-speed generators. This power plant was designed in 1901 and in connection with a further range of 60 miles reaches to the city of Butte. The lines composing this system of duplicate transmission, including the step-up and step-down transformers, were built for the use of pressures of 40,000, 60,000 and 80,000 volts. To reach 100,000 volts for power transmission purposes is but a step which presents no unusual features calling for special consideration. The extensive use of oil insulation for transformers, of air switches in place of oil switches, and of various other changes in insulating methods, point to the attempt which is at this time being successfully made to overcome the difficulties of safe and efficient insulation. It must not be forgotten, that one of the most promine features of expense is this one of insulators and insulation, and success, in reaching over greater distances with these lightning-like pressures is entirely a matter of making cheap and durable, as well as eminently reliable, insulators.

A large power company in Colorado was forced to build its own oil-insulated transformers because of the lack of a guarantee required by it of the manufacturers who were willing to undertake the construction of 40,000 volt transformers only on these negative terms.

It is an extraordinary case of a power company being forced pacifically into the manufacturing business, because they acted as pioneers.

It is interesting to note that the oil in which the transformers were to be immersed was boiled for 24 hours at a temperature of (125 degs. C.) 257 degs. Fah. and the boiling continued for another 24 hours with the transformers submerged. Determination of this kind will soon make even 100,000 volt pressures seem like ancient history.

* * *

The Durability of Telegraph Poles.

As we stated some time ago in these columns, experiments are being made by the Bureau of Forestry of the Department of Agriculture and several prominent telegraph and telephone companies, with a view to increasing the durability of telegraph and telephone poles.

The length of service of a telegraph or telephone pole is determined in a section of the pole not more than a foot or a foot and a half long. In a standing pole this section extends about six or eight inches above and below the top of the ground. This is the universal point of attack upon the life of the pole, and is called its breaking point. Decay is the arch enemy of these poles. It sets in at the ground line and reaches both up and down the pole, but only so far as the conditions exist which promote the growth of wood-destroying fungi. A few inches below the ground there is lack of the necessary oxygen and heat, while at about the same distance above ground the requisite moisture fails. The exact time at which decay begins its work depends upon the climate, the character of the soil, and similar conditions. In a hot, moist climate it ordinarily sets in with great rapidity. But at best, in a very few years after the pole is set the struggle has commenced.

The strain upon the pole from wind pressure and the weight of its cross-arms and wires is calculated for the ground line. When the diameter of this ground line is constantly decreased, the strength of the pole is proportionately reduced, and it becomes only a question of time when the pole must fall. Chestnut and white cedar have been found, among available woods, most successfully to resist decay, but the life of the former is only from 12 to 15 years and of the latter 10 to 12 years. The co-operative study of the Bureau of Forestry is for the purpose of extending, if possible, this time.

The experiments already made show conclusively that poles can be subjected to a preservative treatment which insures materially lengthened service. This treatment consists in impregnating the wood with antiseptics which prevent the growth of the fungi that cause decay. The treatment of telegraph and telephone poles, when attempted at all in this country, generally has been applied to the whole pole, requiring the use of air-tight cylinders 100 feet long or more. In these the poles are subjected to live steam for some time, when a vacuum is created. Creosote is then run in and pressure applied to force it into the wood. Manifestly this is a laborious process. Yet for telegraph and telephone poles only about one foot of the entire length needs to be made immune from fungus, according to the theory of the Bureau of Forestry officials. If this foot at the fatal ground line can be preserved from decay, the rest of the pole will take care of itself. Experiments will now be made in treating the butts of the poles for a distance of about eight feet, thus carrying the antiseptics just beyond the zone of decay attack. The creosote method will be used and the dead oil of coal tar forced through the butt of the pole.

The telegraph companies have made little use of preservative treatment. They employ millions of poles on their various lines, and it would be a tremendous economy to add even a few years of service to the life of each pole.

Another feature of the co-operative work will be the treatment of cross-arms. The companies have been treating them, but report too much absorption in some cases and not enough in others. The Bureau of Forestry will more carefully grade the different kinds of wood and treat each class separately. In this way it is expected to secure a more equal absorption and more satisfactory results. There are the main points covered by the contracts, though in addition the Bureau of Forestry will furnish information on the supply of pole timber and such general advice as may be suggested by the co-operative work.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The output of electrical apparatus for 1904 is placed at $175,150,000, an increase of $17,000,000 over 1903.

Interborough officials are highly pleased by the showing made by the subway in this city last week. While some of the surface roads were tied up completely and the elevated lines were run irregularly, the underground lines have run as smoothly as they would in mid-summer.

The next convention of the American Institute of Electrical Engineers is to be held this year in Asheville, N. C.

The New York Board of Rapid Transit Railroad Commissioners will meet in its office 320 Broadway, on Thursday, January 12, at 2:30 P.M., to give a public hearing on the report of William Barclay Parsons, chief engineer, suggesting extensions of rapid transit, etc., in the Boroughs of Manhattan, the Bronx and Brooklyn.

Major Woodbury, street cleaning commissioner of New York, in a special report to the Mayor, says that the city refuse, burned scientifically, as it is in certain English towns, will supply three times as much electric lighting as the city now pays for. As the city's annual bill for electric lighting is more than $1,000,000, it could cut this in two by using refuse to generate electricity, and have a revenue of nearly $2,000,000 by selling to private consumers. Major Woodbury's engineering data are furnished by James C. Baylis, his consulting engineer.

The copper production of the world for 1904 is placed by one authority at 632,166 tons, against 578,876 tons in 1903 and 542,167 tons in 1902.

The Southern Pacific is to make a test of an internal combustion engine burning crude oil, and furnishing power for dynamos that generate electricity with which to operate a motor that turns the wheels. In theory it can be operated at one-half the cost of a steam locomotive, is capable of a speed of from 100 to 120 miles an hour, and carries enough fuel to run from New York to San Francisco without renewing the supply.

The thirteenth annual convention of the Northwestern Electrical Association will be held at the Hotel Pfister, Milwaukee, Wis., commencing on Wednesday morning, January 18. Reports and papers on subjects of special interest to central station and street railway men will be read and discussed. An attractive entertainment programme is being arranged, and a pleasant and profitable time is assured to all who attend the convention.

Judge Hazel, in the Circuit Court of the United States for the Southern District of New York, has decided the test suit brought by the New York Phonograph Company against Thomas A. Edison, the National Phonograph Company and the Edison Phonograph Company for an accounting for all sales of phonographs and phonograph supplies made by Mr. Edison and his companies in the State of New York, since the organization of the National Phonograph Company in 1896. As the business done by Mr. Edison and his companies within the State since 1896 has been of great magnitude, it is quite possible that the amount to be accounted for may run up into the millions.

Signor Marconi on Friday, according to a cable dispatch, presented his compliments to the King of Italy who received him with great cordiality. Signor Marconi assured the King that the new wireless stations in Italy will correspond directly with Turkey, Greece, Hungary and the Italian colony of Eritrea, in Africa.

BULL ELECTRO-MECHANICAL WIRELESS TELEGRAPH SYSTEM.

BY A. FREDERICK COLLINS.

A new European system for the wireless transmission of intelligence was recently tried by the Board of Wireless Telegraphy at the Brooklyn Navy Yard, and the results obtained were highly interesting.

The system in question is the invention of Mr. Anders Bull, of Copenhagen, Denmark, and differs in every respect from those that have been previously invented, inasmuch as the Marconi, Slaby-Arco, Braun and Fessenden systems depend on electrical resonance for their selective qualities, while the Bull system utilizes the ordinary non-syntonized sending and receiving apparatus in combination with electro-mechanism to produce these effects.

There is, it should be borne in mind, a great difference in a "selective" system and one that is "non-interfering;" a selective apparatus implies that a message sent from a given station may be received by any one of a number of receivers to the exclusion of all others, while a non-interfering system is one that is not affected by electric waves radiated from any other one, or a number of other transmitters.

Practically there is such a thing as a selective wireless telegraph system, but there is no such thing, except in theory, as a non-interfering system of wireless transmission. While in the present state of the art it is impossible to prevent interference, it is often a great convenience to send a message to a certain given station to the exclusion of all others, and this the Bull system does.

The broad general principles incorporated by Bull in his electro-mechanical methods require a little description before the details are entered into. First of all, the transmitter and receiver are neither tuned individually, nor syntonized collectively. Any kind of a wireless telegraph system may be employed for the purpose of generating and indicating the waves. The Bull apparatus is an auxiliary, feature that when added to any kind of a transmitter and a receiver, becomes an inherent part of it, performing certain well-defined functions, and thereby rendering it selective in its performance.

The apparatus proper consists of a "disperser" and a "collector," as the sending and receiving devices are called, the purpose of the first being to send out a series of pre-arranged wave impulses, and the second to convert these into current impulses. This is done by having two disks, one at either end, rotate in synchronism with each other; each of these disks have contacts that are brought to bear on a number of straight steel springs at predetermined intervals, as will be more clearly indicated later, so that if three series of waves are emitted in a second, these on reaching the receiver will act on the steel springs in the same period of time, and thus close the circuit of the relay, whereas any other series will have no effect whatever.

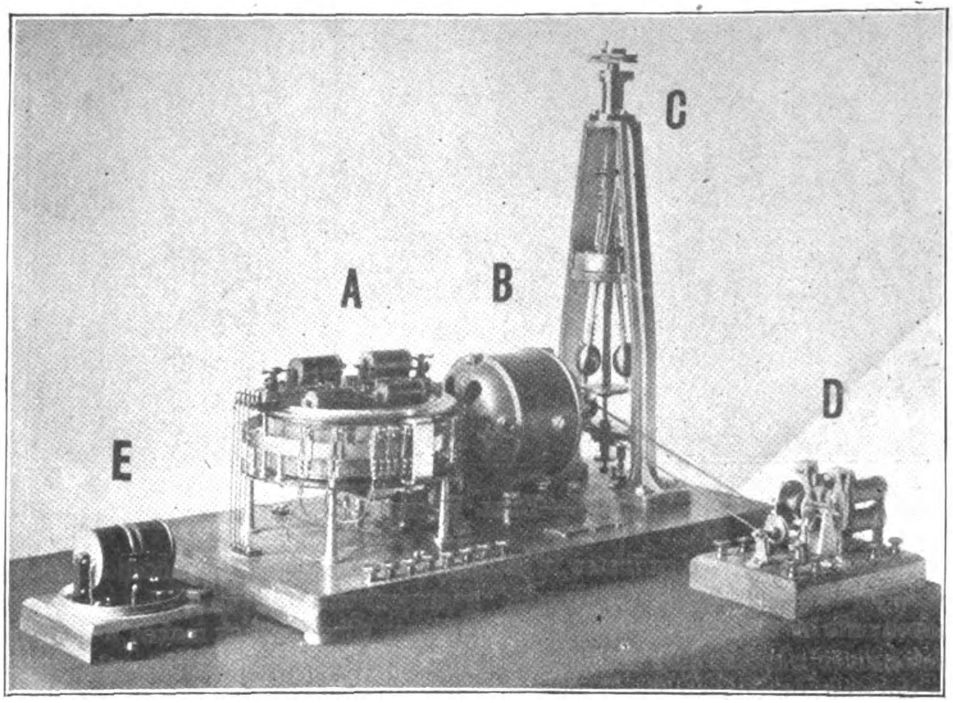


FIG. 1.—THE DISPERSER.

The disperser compresses an electro-mechanical device A, which contains the revolving disk, straight steel springs, electro-magnets and contact points; this is operated by the electric motor B, its speed being subjected to close regulation by means of a Siemens & Halske governor C; an electro-magnet and revolving element for breaking up the primary circuit into a number of impulses during a given period of time is represented at D, while an electro-magnet for making and breaking the circuit of the induction coil of the sending apparatus is shown at E.

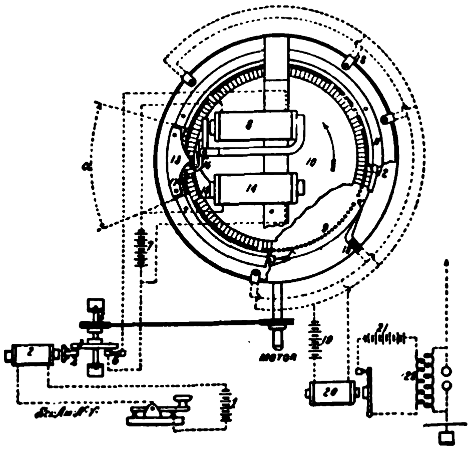


FIG. 2.
The Transmitter, Showing Connections Between Disperser and Induction Coil.

Listed in detail, the entire equipment for sending is made up of an ordinary Morse telegraph key connected in series with a battery 1, and the windings of an electro-magnet 2 (see diagram Fig. 2); the armature of this magnet is attached to a clutch, which may be better understood by reference to the side elevation, Fig. 3; on the surface of the disk 3 a pin engages the clutch 4, attached to the armature, once during every revolution of the disk.

The disk rotates by frictional contact with the shaft 5, thus making approximately five revolutions per second; 6 are spring contact points for closing the circuit including the battery, and the electro-magnet 8. To the disk of the disperser proper, 400 steel springs are attached in such a manner that they stand vertically to the plane of the disk.

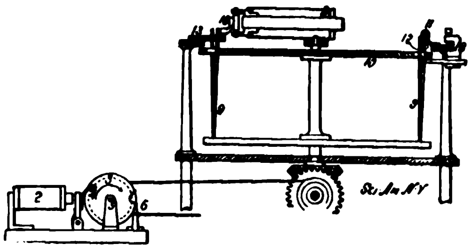


FIG. 3.—SECTIONAL VIEW OF DISPERSER.

In an upper and oppositely disposed disk 10, which, with the first, is mounted on the same shaft or spindle, radial slots are cut, the free ends of the steel springs passing through these, the slots permitting the springs to bend in a radial line only in relation to the disk itself.

The frame supporting the shaft carrying the disks has a brass ring 11, secured to it, the latter acting as a guide for the springs; thus, as they revolve, they may slide within the ring itself, or within the U-shaped groove 12, the bronze arc 13, with its sharp projection extending toward the circularly arranged springs, causes these to bend toward the core of the electro-magnet.

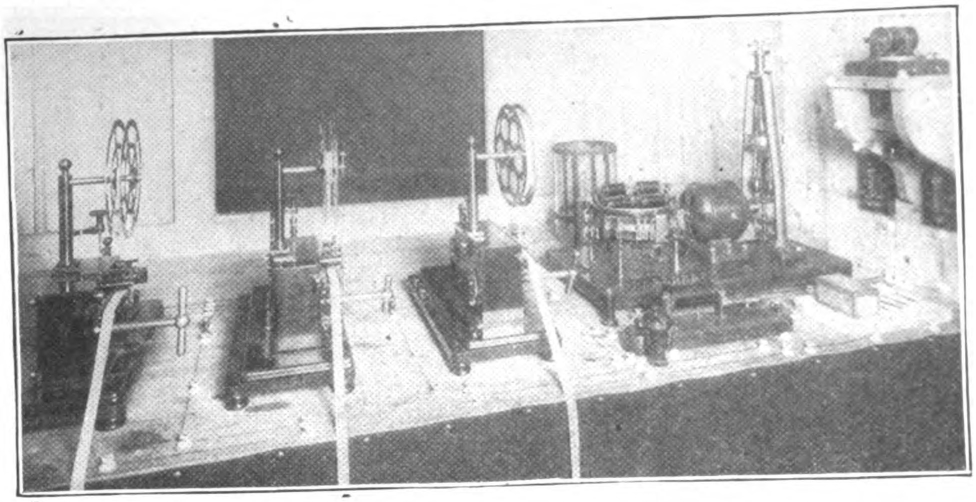


FIG. 4.—BULL RECEIVER.

The end of this core terminates in a curved arm, while a finger 16 directs the movements of the springs; the point that determines whether they are to slide within the ring, or pass into the U-shaped groove, is shown; a number of contact points 18, formed of two contact springs insulated from each other, are attached to the frame.

These are the constituent parts of the disperser, the battery serving to connect the contact points with the magnetic circuit closer 20; a third battery 21, Fig. 2, is connected in series with the primary winding of an induction coil 22, the spark-gap and oscillator system completing the transmitting apparatus.

The collector or receiver device shown in the cut, Fig. 4, and the diagram, Fig. 5, is an exact counterpart of the disperser in so far as the mechanism employed is concerned, but when used as a receiver it is connected with the system which includes the aerial and earth wire and a coherer; these are not indicated by numbers, but with the relay 23, the numerical systematization again begins; the electro-mechanical tapper 24 is of the usual type, the collector magnet 25 being in shunt with it; the groove for the springs is shown at 26. The contact points 27 of the collector are arranged in the same relative positions as they are in the disperser and these are connected in series with the Morse system.

Having defined the various necessary parts of the Bull system it is now in order to review the operations of sending and receiving a selective wireless message. Beginning at the transmitting end the first effort consists of the manipulation of the Morse key. When the first circuit is closed through the key the current from the battery, Fig. 2, energizes the electro-magnet 2; this attracts the armature, permitting the disk 3 to revolve, which it does at the rate of five revolutions per second, by drawing the clutch out of engagement with the pin 4.

Every time the disk makes a complete revolution the pin 3 strikes the spring contacts 6, closing the circuit, which includes the battery 7 and the electro-magnet 8. Now, if the Morse key is depressed only long enough to represent a dot, this being less than one-fifth of a second, then the clutch will engage the pin and the disk will be brought to a full stop when it has made one complete turn. It is evident that the magnet 8 will be energized with a single impulse, but if a dash is sent the disk revolves several times when the successive impulses energizes the magnets at intervals of one-fifth of a second.

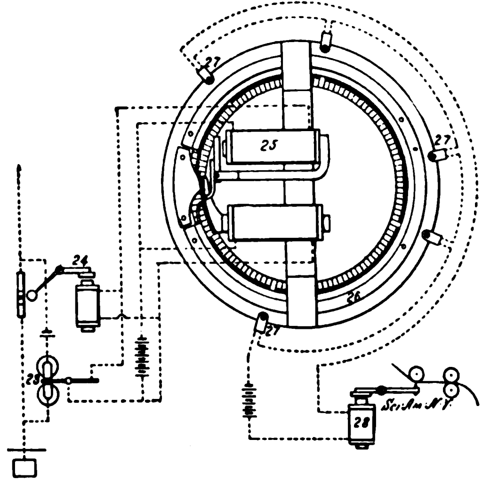


FIG. 5.
The Receiver, Showing Connections Between Coherer Relay, Morse Register and Collector.

In this case the steel springs 9 on the larger disk, which makes one revolution every second, are guided over the polar projector 15 of the magnet 14 in shunt with the battery 7, the finger 16 is fastened to the armature of the magnet 8 and when this is attracted the springs are turned out of their normal course into the U-shaped groove 12, remaining there until the disk has completed its cycle.

When the springs move in the U-shaped groove they make connection with the contact points 18, since they project a little beyond the normal circumference of the points themselves. It is easy to see that by closing the circuit formed by the battery 21 the induction coil 22 will also be closed and that trains of waves will be set up that are periodic both in time and space.

As the disk of the collector revolves at exactly the same speed as that of the disperser, no matter how great the distance separating these may be, the electric waves sent out by the transmitting aerial will, on reaching the receiving aerial wire, be converted into electric oscillations representing similar periodic impulses and these break down the high internal resistance of the coherer when the local current operates the relay 23; this brings into action a battery that energizes the magnets of the decoherer 24 and those of the collector magnets 25.

It must be apparent now that for each series of wave impulses one of the straight steel springs will be brought into the groove 26; thus if five electric waves series are transmitted, five springs will be brought into the groove of the collector at space intervals representing the intervals of time between the series of waves.

As the contact points in the collector are arranged exactly as they are in the disperser, all of them must be brought into contact simultaneously; hence the circuit which includes the Morse register is closed and the dot and dash is imprinted on the tape. A disperser having any other combination than the collector would not, of course, cause every contact of the latter to be closed at the same instant and this would permit the Morse register circuit to remain open.

In the trials made in Copenhagen by the inventor only one transmitter and one receiver were employed each of these having three sets of contact points and any one of these three combinations could be used to the exclusion of the other two by merely cutting them out by means of a switch. The collector had three Morse registers connected to the various sets of contact points and by making the points of both instruments correspond any one of the three registers could be operated selectively.

In the tests just concluded at the Brooklyn Navy Yard the apparatus operated admirably and proved beyond the peradventure of a doubt that wireless telegraph messages may be sent selectively by the adoption of the Bull system. It is the first time on record that selective messages have ever been actually accomplished in America.

TELEPHONE PROTECTIVE DEVICES.

BY RALPH SCOTT.

(*Concluded from page 5.*)

On account of the great increase of the application of high tension circuits and their coincident installation with telephone circuits, it is necessary that the latter be protected against crosses with the former. Among such high tension circuits may be mentioned street railway, power and lighting systems, especially where alternating current is used.

Although a dynamic current of even a very high voltage is not capable of jumping across even a very minute air space, when an arc has once started by a static discharge passing across this gap, a dynamic current in the form of an arc will continue across this path even though it be of comparatively great length.

This arc, by fusing the circuit wires, may cause a permanent connection at this point which may thus result in the telephone circuits carrying a high tension current. It is necessary, therefore, that a good protector open the circuit before entering the building. Hence, it is essential that combination protectors be used which will provide a good path to the earth for not only the high tension current but also the static discharge. It is also necessary that a fuse be so located that when a cross occurs with a high tension circuit it will not only handle this discharge but also be so sensitive that in the case of sneak currents, or partial crosses, it will interrupt the circuit and thus protect the instrument.

In Fig. 9, a device which depends in action upon the electromagnetic effect of a current, is shown. One side of the instrument to be connected is connected to the end N of the electromagnet R. The other end of the magnet is connected to the frame D. The pivoted armature O, held upward by the adjustable spring C is provided with a catch A, which holds the pivoted lever L in the position shown; L tends to move away from the restraining catch A, because of the spring S. When an excessive current passes through R, from N to E, the armature O is attracted, thus allowing L to fly outward, and introduce a wide air-gap, which disrupts any consequent arc.

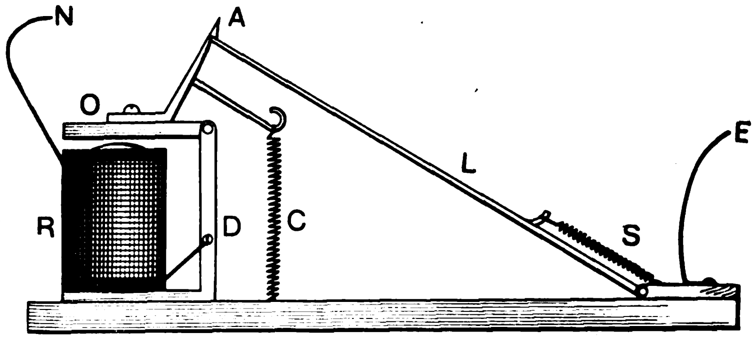


FIG. 9.

In Fig. 10 is shown the simplest form of protector against excessive currents. Upon a suitable base the binding posts N and A are placed, to which are connected the line and instrument wire respectively, and between which is placed the fusible wire D. On the passage of an abnormal current, the thermal effect is sufficient to melt D, thus introducing a wide air gap between A and N.

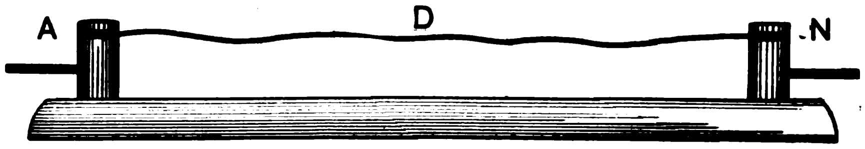


FIG. 10.

Modern telephone protective devices may be classified into the following subdivisions: (a) Protectors for switchboards at the exchange; (b) protectors for cables, which usually are placed upon line poles; (c) protectors for the instruments at the subscriber's end of the line.

It is now recognized that a perfect system of protection must include both line wire and instrument fuses, a self-heating coil, a carbon plate lightning arrester (single pole for grounded circuits and double pole for metallic circuits) and also a grounding device by means of which any separate line may be connected to ground.

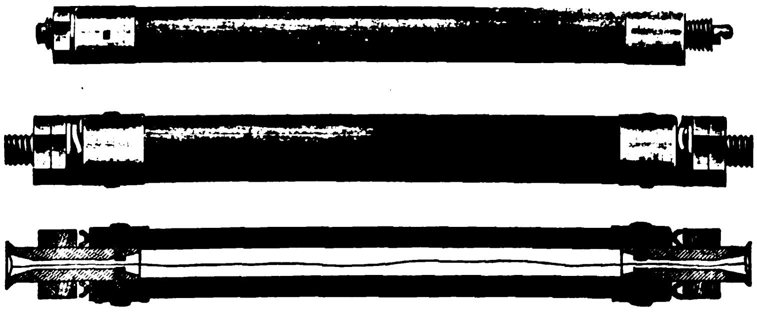


FIG. 11.

Although a great number of devices for accomplishing the above purposes have been placed upon the market within the last few years, nearly all are similar in principle, and a description of one standard form may serve as a description for nearly all other devices which perform the same function.

The old style protectors usually employed a self-heating coil which opened the circuit by the melting of either a soldered or waxed connection, which, when the device had operated, required renewing. As a matter of fact, a protector which is designed after these principles is usually not only complex but also clumsy, as the principle of operation is not ideal.

For this reason there are a number of so-called self-soldering devices on the market, which, by the use of a suitable arrangement of contacts and parts, are reset for another operation of the protective part after having been disrupted by an excess of current. Present practice demands that a telephone protector should fulfill the following conditions:

1. It should be provided with a self-soldering or self-restoring heat cartridge or other readily renewable arrangement, which will require but little time to replace after the same has operated by the flow of an excessive current.

2. The protective coil or cartridge should be in such a position and having such connection that it may be readily tested and operated any number of times without any change in the relative efficiency of the device.

3. The heat coil should have a definite and invariable rating, so that it will not

pass a greater current than that at which it is rated for any length of time.

4. The springs or other means employed for operating the device on the passage of an excessive current should be of such construction that their long continuous use in their strained position will not effect their resiliency. The tension of the springs should be such that a good contact is maintained, and also that when open it will introduce a liberal air-gap.

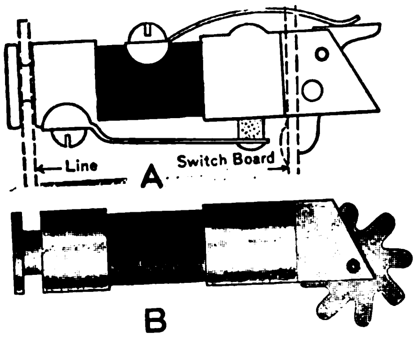


Fig. 12.

5. The air-gap between the contacts should be distinct in such a manner that, when the parts are in open condition, there will be no liability of any contact or short-circuiting action between any of the other parts of the instrument.

6. The grounding device should be of such construction that a permanent ground will be assured when operated.

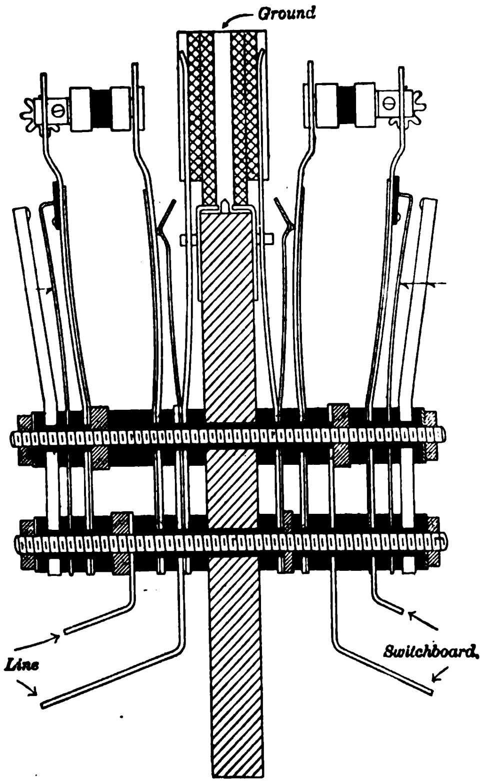


Fig. 13.

7. All contacts should be in a readily accessible position, so that in case of uncertainty of action the parts may be readily inspected. On switchboard protectors it is necessary that the usual testing arrangement be readily applied.

8. The lightning arrester employed should be positive in action and also self-cleaning. Its construction should also be such that an altering of the position of the parts after leaving the factory will be a remote possibility.

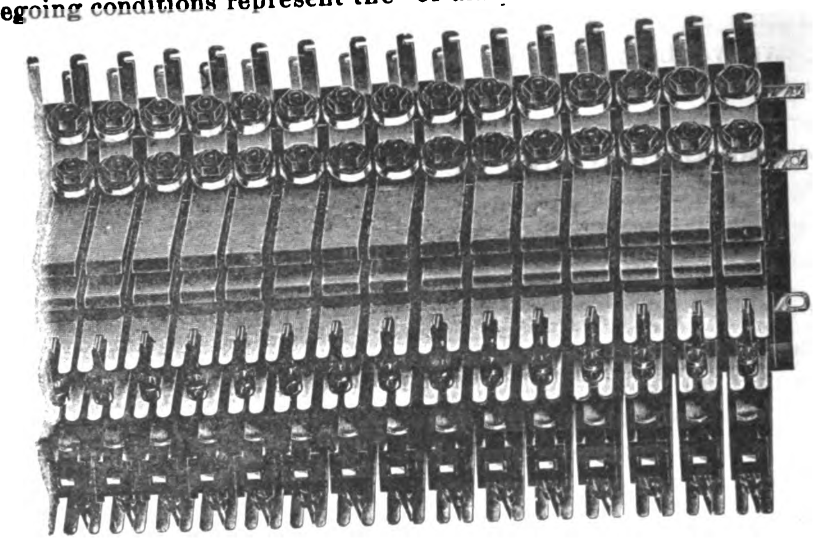


Fig. 14.

The foregoing conditions represent the practical requirements after which all protectors should be designed. The primary object of a protector is protection. This, therefore, should be the objective point of all such designs,

Tubular line fuses, which have been largely applied to the protection of open telephone lines, are usually placed at the outside of the building and fastened to a break in the line itself. Such line fuses are shown in Fig. 11, and consist essentially of fiber tubes with suitable end connecting and clamping means. Through the center of this tube is passed a fine fusible wire, which, when disrupted by an excessive current, is converted into a gas, the high resultant pressure effectually quenching any coincident arc.

In Fig. 12 is shown two forms of self-soldering heat cartridge. The type shown at A consists of a graphite rod of high specific resistance, to which suitable end connecting means are fastened. One of these end terminal pieces contains solder, which normally holds the pivoted contact piece in place, thus holding the contact spring in its tension position. When an abnormal current passes through the graphite rod, the heat generated melts the solder and releases the pivoted piece. After release the top spring forces the pivoted piece in its original position, thus resetting the device. At B is shown a star wheel cartridge, which consists of a heat coil housing fastened to a wheel by solder. In operation the wheel turns, thus releasing the spring and resetting the wheel.

In Fig. 13 is shown a section of a standard form of telephone switchboard protector. This shows the method of operation, and also the construction of the component parts. The heavy outside strips on each side and the adjacent spring pieces which are insulated from the cartridge springs constitute the local or alarm circuit.

On each side of the centrally located ground plate the carbon lightning arresters are placed. The heat cartridges are shown in their normal condition, that is, before having operated. The central or ground carbon block is square, being provided with a square aperture, which slips over a grounded rod. The line and

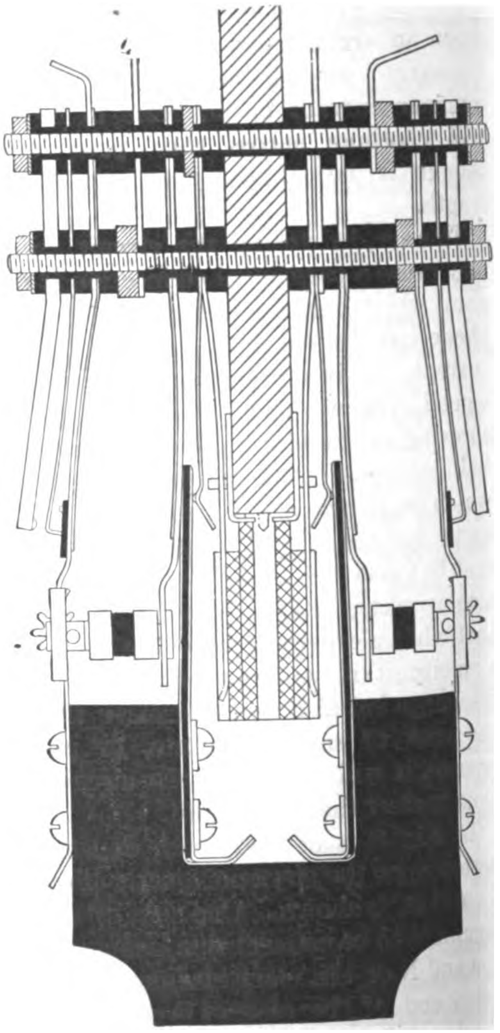


Fig. 15.

switchboard lugs are beneath the row of protectors.

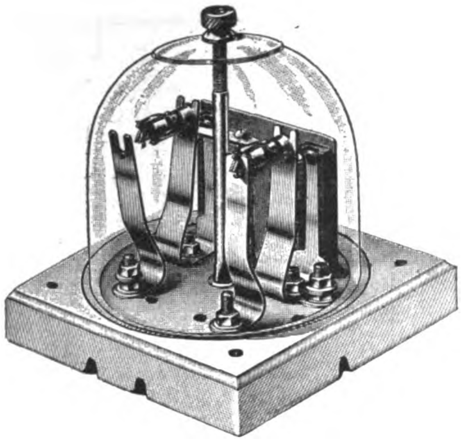


Fig. 16.

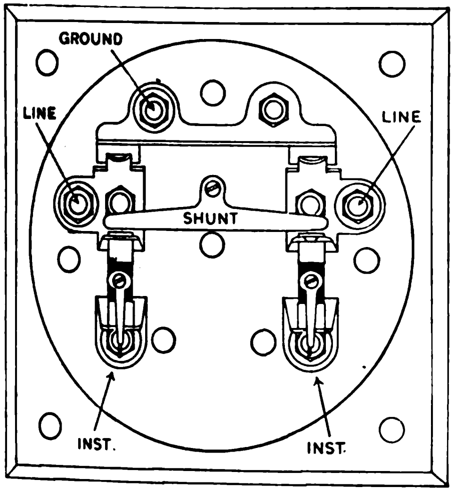


Fig. 17.

The protector, in operation, causes the local or alarm circuit to be closed, opens the line circuit, and shunts the excessive current to ground, these operations being accomplished very quickly. The heavy current, in passing through the cartridge, softens the solder and allows the wheel to revolve, which releases the springs holding the cartridge in place, thus causing the outer spring to close the local circuit, and the inner spring to ground, the line circuit being at the same time opened and an air-gap of one-half inch being introduced. A bank of these protectors is shown in perspective in Fig. 14.

In Fig. 15, the manner of testing a switchboard protector by means of a standard test plug is shown. By means of this arrangement it is possible to make any of the usual telephone tests without distributing even the individual protector. There are three distinct sets of contacts, by means of which any of these tests, either in series or multiple, may be made.

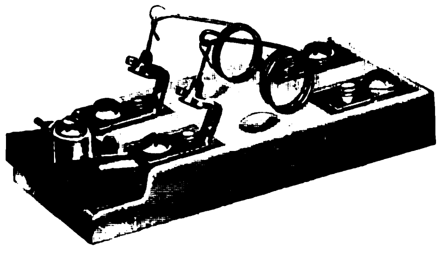


Fig. 18.

In Fig. 16 is shown a self-soldering heat coil and arrester protector. A diagram of the connections and arrangement of the parts of this instrument is shown in Fig. 17, which is self-explanatory. The operation of either heat coil causes the spring on the latter to come in contact with the pivoted shunt bar, which successfully shunts the instrument. On replacing the release spring, the shunt is removed. Two forms of heat coil protectors with spring release are shown in Figs. 18 and 19. The arrangement in Fig. 18 consists of movable heat coils only, the springs and contact pieces being rigidly secured to the porcelain base. The instrument shown in Fig. 19 has removable heat coils and springs, these being placed on fiber bars provided with contact clips, which may thus be removed expeditiously.

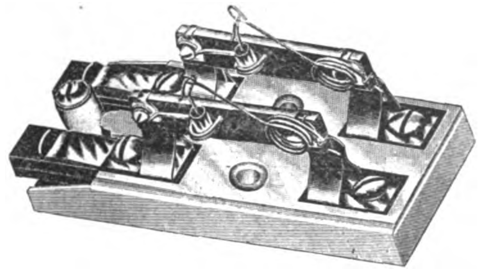


Fig. 19.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

ELECTRO-MAGNETISM.

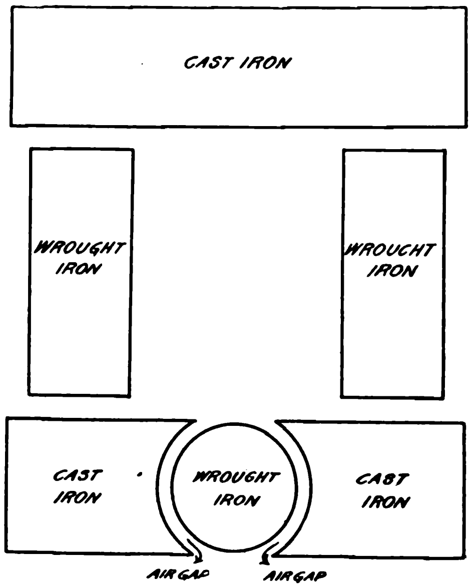
Winding Magnets.—The winding of magnets is accomplished by considering first the number of lines of force per unit of area of cross-section and, secondly, the number of ampere turns required to produce a uniform magnetic condition throughout the iron, steel or air under process of magnetization. The number of lines of force per square inch of cross-section is the basis of most estimates made in this direction. But the other important fact to consider is the number of inches which represents the total length of the magnetic circuit.

The Hopkinson Method.—The estimates of the amount of magnetism produced from a magnetic circuit only became accurate through the application of the method of John Hopkinson, an English scientist and engineer.

This method consists of the division of the magnetic circuit into its separate parts, such as the cast-iron, the wrought-iron and the air-gap. Each part carries a certain number of lines of force per square inch and has a certain length. In other words, it is necessary to provide a certain magneto-motive force for each distinct part of the magnetic circuit. All of these magneto-motive forces are added together in the shape of a sum total of ampere turns constituting the field winding. Thus two processes come into view: First, that of obtaining the total magneto-motive force and, second, that of obtaining the correct winding, size of wire, etc.

Taking a practical view of the Hopkinson method it is evident that it calls for the use of curves already made with reference to the metal, whether wrought or cast-iron, under consideration.

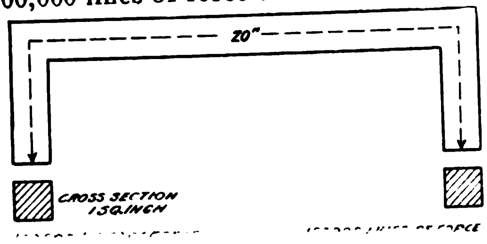
To illustrate the idea involved in its application take the case of a dynamo which, as seen in the illustration, represents a magnetic circuit composed of many parts—the keeper of cast-iron, the magnet cores of wrought-iron, the pole pieces of cast-iron, the armature core of wrought-iron and finally the air-gap lying between the armature core and the pole pieces. The problem from an everyday practical standpoint is that of finding the total number of ampere turns required to force a given number of lines of force through the armature core from pole piece to pole piece. In order to do this, as stated before, each individual part of the magnetic circuit must be provided with sufficien magneto-motive force to develop in it the amount of magnetism or number of lines of force required to establish this result.



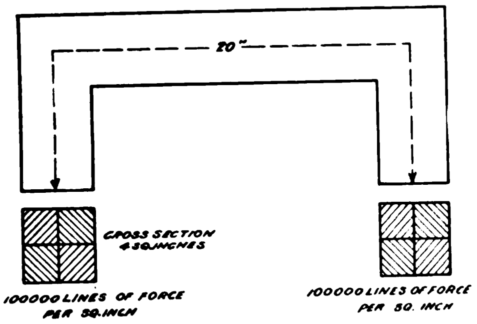
Parts of a Dynamo.

Suppose, for purposes of illustration, in order to send 100,000 lines of force per square inch through wrought-iron it takes 92 ampere turns per inch length.

Then, if the bar is 20 inches long and of 1 square inch cross-section and carries 100,000 lines of force the number of ampere turns required would be equal to 20 × 92 = 1,840 to produce the induction, as it is called, per square inch. If a magnetic circuit of the same material, the same length, but four times the cross-section is considered, then the fact to be remembered is this—that here the length of the magnetic circuit has not changed and therefore the magneto-motive force will not be any greater than in the first case; but the cross-section of the iron being four times as great means a magnetic reluctance of one-quarter and therefore four times as many lines of force in consequence.



Total Field 100,000 Lines of Force.


20"
CROSS SECTION 4 SQ.INCHES
100000 LINES OF FORCE PER SQ.INCH
100000 LINES OF FORCE PER SQ. INCH

Total Field = 400,000 Lines of Force.

The same number of ampere turns would be required for either bar of wrought-iron because the length and quality of the iron of each is the same. Now it does not make much difference whether these ampere turns are placed along the whole length of the bar or at one portion of it. The total number required in this particular case is 1,840 to produce 100,000 lines of force per square inch throughout the bar. The bar might have a cross-section of 100 square inches, if it has the same length the same number of ampere turns will be required to give every square inch of its cross-section an induction of 100,000 lines per square inch. The important part is to provide the required number of ampere turns per inch length. These figures, for different grades of iron or steel can be obtained from curves or tables. A very important table of this character, prepared by Alfred E. Wiener, E.E., is here given for the uses indicated, namely, the calculation of the ampere turns of any magnetic circuit of any material in ordinary use.

UNIT MAGNETO-MOTIVE FORCES.
Ampere Turns per Inch Length.

Magnetic Density. Lines of Force Per Square Inch.	Annealed Norway Iron.	Soft Cast Steel.	Mitis Iron.	Cast Iron Containing 6.5 of Aluminum.	Cast Iron (ordinary).	Air (.3133xH).
2,500.	1.2	2.	2.5	7.	9.	783.
3,000.	1.7	2.8	3.4	9.6	13.	1,566.
7,500.	2.1	3.4	4.	11.6	16.	2,350.
10,000.	2.2	3.7	4.4	13.5	18.5	3,132.
12,500.	2.4	4.	4.8	15.7	21.3	3,916.
15,000.	2.7	4.3	5.2	18.2	24.1	4,700.
17,500.	3.1	4.6	5.6	21.	27.1	5,483.
20,000.	3.5	5.	6.	24.	30.5	6,266.
22,500.	4.	5.4	6.5	27.2	34.5	7,050.
25,000.	4.5	5.8	7.	31.	39.	7,833.
27,500.	5.	6.2	7.5	35.5	44.	8,616.
30,000.	5.5	6.6	8.1	41.5	50.	9.400.
32,500.	6.	7.1	8.7	47.5	57.	10,162.
35,000.	6.5	7.6	9.4	54.	65.	10,966.
37,500.	7.	8.2	10.1	62.	76.	11,750.
40.000.	7.5	8.8	10.9	72.	88.	12,532.
42,500.	8.	9.4	11.7	83.	101.	13,315.
45,000.	8.5	10.1	12.6	95.	116.	14.100.
47,500.	9.	10.9	13.6	110.	136.	14,882.
50,000.	9.6	11.8	14.7	128.	160.	15,665.
52,500.	10.3	12.8	15.9	149.	189.	16,450.
55,000.	11.1	13.9	17.3	173.	222.	17,233.
57,500.	12.	15.1	19.	200.	260.	18,016.
60,000.	13.	16.2	21.	230.	295.	18,800.
62,500.	14.2	17.8	23.2	263.	340.	
65,000.	15.7	19.3	25.6	300.	400.	
67,500.	17.5	20.9	28.5	345.	470.	
70,000.	19.6	22.7	32.	400.	570.	
72,500.	22.	24.7	36.	460.	700.	
75,000.	24.7	27.	41.	525.		
77,500.	27.7	30.	47.	600.		
80,000.	31.2	34.	54.	700.		
82,500.	35.2	39.	62.			
85,000.	39.7	44.	70.			
87,500.	44.7	50.	80.			
90,000.	50.7	57.	92.			
92,500.	58.	68.	109.			
95,000.	67.	75.	131.			
97,500.	78.	86.	150.			
100,000.	91.	100.	193.			
102,500.	108.	121.	245.			
105,000.	137.	159.	283.			
107,500.	190.	227.	345.			
110,000.	290.	325.	410.			
112,500.	398.	430.	500.			
115,000.	500.	550.	600.			
117,500.	600.	650.	700.			
120,000.	700.	750.	800.			
122,500.	800.	850.				
125,000.	900.	950.				

Referring to the first sketch it is now easy to see that the Hopkinson method would call for this process with reference to the table obtained from magnetic curves.

1—Lines of force per square inch in cast-iron keeper and the corresponding ampere turns per inch length.

2—Lines of force per square inch in wrought-iron cores and the corresponding ampere turns per inch length.

3—Lines of force per square inch in cast-iron pole pieces and the corresponding ampere turns per inch of mean length.

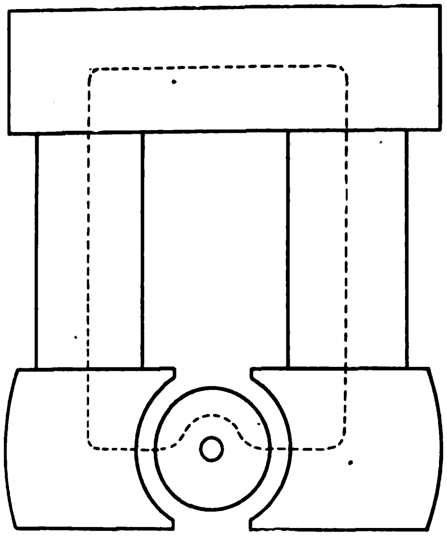
4—Lines of force per square inch in wrought-iron armature and the corresponding ampere turns per inch of length.

5—Lines of force per square inch of air gap and the corresponding ampere turns per inch or percentage of an inch of length.

The selection of the mean path through the parts of a dynamo is shown by the dotted lines in the sketch. After getting the total ampere turns for each part of the dynamo the following schedule is arranged:

Ampere turns for magnet cores....	1,000
" " " keeper..	200
" " " pole pieces......	300
" " " armature core...	100
" " " air gaps........	2,400
Total ampere turns...........	4,000

With the total ampere turns, the next step is to find the proper size of wire as called for by the electromotive force of the armature which supplies the field winding, Formula for Winding.—The simple formula employed for the winding calls for a knowledge of the total ampere turns, the volts to be applied to the terminals of the coils, and the average or mean length of one turn. This last is obtained by taking the diameter of the magnet core and adding to it the anticipated depth of winding in inches. Between these two an average is obtained and multiplying by π gives the length in inches, called the mean length of a turn. The size of wire is given in circular mils.



SHOWING MEAN PATH OF MAGNETIC LINES OF FORCE THROUGH THE FRAME OF A DYNAMO.

Circular mils =

$$\frac{\text{Total amp. turns} \times \text{mean length of turn}}{1.106 \times \text{volts of coil}}$$

$$\text{C. M.} = \frac{\text{A. T.} \times \text{M. L.}}{1.106 \times \text{E}}$$

Suppose in the case of a dynamo whose total ampere turns equal 4,000, the mean length of a turn equals 12 inches, the size of wire required equals the following at 110 volts:

$$\frac{4{,}000 \times 12}{1.106 \times 110} = 312 = \text{No. 25 B. \& S.}$$

gauge nearest size.

Allowing 1,000 circular mils per ampere gives a current of .325 of an ampere. Dividing amperes into ampere turns gives turns = 12,307; as each turn is about 1 foot there are approximately 12,000 feet of wire.

The temperature of the coil must also be considered, because the greater the amount of power dissipated in the coil in the form of heat the higher its temperature becomes. This will destroy the coil unless regulated by the outer surface of the coil itself and the depth of winding. A simple formula gives the temperature in degrees Fahrenheit to which a coil will rise when two things are known, the watts wasted in the coil and the number of square inches of radiating surface to the coil.

Obtaining the Watts Wasted.—To obtain the watts wasted in heat in the coil, the resistance of the wire in ohms must be multiplied by the square of the current. For instance, in the coil referred to in illustrating the winding formula there are 12,000 feet of No. 25 wire This wire has a resistance of about 32 ohms per 1,000 feet or a total of 32 × 12 = 384 ohms. The current this coil carries is equal to its circular mils divided by 1,000, or

$$\text{Current in coil} = \frac{\text{circular mils}}{1{,}000} = .325.$$

The number of watts wasted are equal to ohms × the amperes squared = .325 × .325 × 384 = 41 watts.

Temperature Formula.—The formula for calculating the temperature is as follows:

$$\text{Degrees Fah.} = \frac{100 \times \text{watts wasted}}{\text{sq. in. of radiating surface}}$$

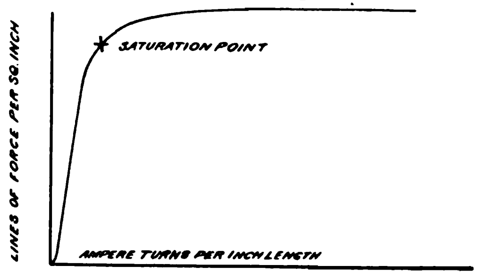
The watts wasted in this case are equal to 41, and if the square inches of radiating surface equal 100, the total rise of temperature in degrees Fahrenheit would be

$$\text{Degrees Fah.} = \frac{100 \times 41}{100} = 41 \text{ degs.}$$

This is not an excessive temperature and can be allowed.

The point to grasp is the influence of an increase or decrease in the radiating surface upon the temperature of the coils. The amount of heat generated in a coil due to the resistance and current is about constant under ordinary circumstances. If the means by which this heat can escape are limited the temperature rises. On the other hand, if the radiating surface of the coil is large the heat readily escapes and the temperature is lower. The problem is largely one in physics, where the heat is limited in quantity but the surface through which the heat escapes can be made larger or smaller, in which case the temperature drops or rises. If, for instance, the heat of a candle flame is concentrated at a point, that point would rise to the temperature of blinding incandescence. On the other hand, the heat, if imparted in its entirety to a large body of necessarily large radiating surface, would escape at a low temperature. The temperature of the body, therefore, is as much a question of the radiating surface, its character and extent, as the amount of heat it represents. In the case of a coil the temperature should not rise much above blood heat or 100 degs. Fah. If the coil develops a temperature of its own of 41 degs. and the surrounding air is at 60 degs. then the total temperature would be 60 + 41 degs. or 101 degs. If a coil of this kind is used in a place unduly heated, or, if it be put into operation near the tropic belt, then the temperature of the coil would become excessive. The surrounding atmosphere must be considered in the design of magnet coils, particularly when they constitute parts of dynamos in use in engine rooms whose temperature is generally very high. The resistance of a winding is increased by its own heat, and this to some extent cuts down the flow of current, which is otherwise very sensitive to changes of resistance, particularly when the resistance falls.

The Magnetization Curve.—The curve which shows the internal condition of the iron is called the magnetization curve. It is obtained by plotting a curve whose elements consist of ampere turns per inch length and the number of lines of force they produce at each successive stage of magnetization. The value of such a curve in practical work is easily seen when the rise and direction of the curve is noted. The rapid rise of the curve with a very small magnetizing force shows how sensitive the iron is to magnetic influences when its reluctance is low and its permeability high. The result is a curve which rises with a slight inclination and then begins to bend. The bend of the curve indicates a distinct change in the permeability and consequently the reluctance of the iron. Following the curve for a short distance it is seen to bend with more and more tendency to the horizontal plane, reaching which it begins to move along it. At the critical point, where the bend originally begins, it will be noted that a given magnetizing force in ampere turns does not produce the effect it did before. In fact a little beyond this point it takes a comparatively great magnetizing force to produce a little additional magnetic field.



SATURATION OR MAGNETIZATION CURVE.

This point is called the saturation point and is considered in practice the economical point at which to operate the iron. Beyond this point magnetism is obtained at too great an expense in wire and power. It is about 100,000 lines of force per square inch for wrought-iron and about 80,000 lines of force per square inch for mild steel, of which two metals the majority of dynamo frames of the present era of electric lighting and power transmission are made.

In the curve the base line represents the ampere turns per inch length, the vertical lines, the magnetic lines per square inch of cross-section.

ON BATTERIES WITH REVERSIBLE BOOSTERS[*]

BY C. TURNBULL.

Some time ago I found it necessary to go into the question of having a battery and automatic reversible booster for use on the traction load at Tynemouth. The result of the investigation was the birth of the Lancashire Automatic Reversible Booster, which was brought out under the patents of Mr. McLeod and myself. This is now in considerable use, being made by the Lancashire Dynamo & Motor Company of Manchester. In putting the machine into the various stations a number of points have come up in connection with the batteries, and I wish to deal with them, in hopes that the paper may be of use to such engineers as are putting down batteries for use under similar conditions.

Price for Traction Current.—The method by which the price for traction current is fixed is one of mystery. Sometimes I think that the lowness of the rate obtained for this kind of supply is partly to be accounted for by the fact that we sell in small units. Certainly the reduction from 2d. to 1d. per unit looks a good deal less than the reduction of a year's revenue from, say, £4,000 to £2,000. At any rate, however the price is fixed, it commonly happens that, when a station engineer takes over the management of a station, he finds the glorious tramway load, from which so much is expected, resolves itself into a small output at a remarkably small price, and the problem of making it pay occupies his thoughts for many years to come. I make these remarks here, as in addition to the Greenock case, other instances are coming to light in which the trams are claiming to be supplied at the same rates, or lower, as are in force for ordinary motor load, although it is common knowledge that tram load is of an entirely different description from motor load, and should be dealt with on its own basis. The practice of debiting all stand-by plant which can be used for both lighting and traction, to lighting only, is also not to be commended.

Load Factor.—The large published load factors for traction supply in combined lighting and traction stations are frequently made use of when a low rate for traction is asked. Certainly a 40 per cent. load factor (for I think a figure as high as this has been given) looks a lot better than the 10 per cent. for lighting. Actually, these large load factors are explained by the fact that the traction load is taken as that load which is on at the moment when the highest total combined load is on the station. Seeing that the highest combined load is usually on the station in the winter months, at a time when the traction load is often lower than its normal maximum, this system frequently causes the traction to be credited with a load factor much greater than it actually earns. To take an extreme case—in a station just beginning the highest combined load might be in the summer holidays, when the trams were heavy and the lighting very low. This would give a low traction load factor and a lighting load factor of perhaps 1,000 per cent. In a few year's time, when the station had grown, the lighting load factor might have shrunk to ordinary dimensions, while the traction load factor might come out very high. I think there is a good deal to be said for taking the respective highest loads for calculating the respective load factors. In connection with this we must also remember that while an engine may be run at nearly full load all the time on motor load, on traction load one must always provide a very large reserve of power to meet the grossly fluctuating demands which traction involves, and this does not make for economy in generating the power.

Batteries.—It has now come to be recognized that the best way to deal with a very fluctuating traction load is to put in a battery and reversible booster, and I propose to deal with some of the aspects of this solution of the problem. The idea has gained currency that a booster should be designed to keep the load on the generator always at a steady value. The problem is stated thus, omitting losses in battery and booster for simplicity—the output is 2,000 units per day of 20 hours. Then a 100 kw. generator with a battery and booster will just do the trick. If the maximum load be 200 kw., then the battery should be able to give 100 kw. easily for a short time, so as to meet the peak with the aid of the generator.

In some cases where the output is fairly regular from day to day, and where the maximum demand keeps within limits, this solution of the problem is quite good, and a very efficient and good working plant is obtained by adding a battery and booster to the generator. In many cases, however, this solution is of no use at all. The output varies from day to day. Likewise a large part of the day is slack, with a heavy output during certain hours only. If in addition to this we have heavy and irregular peaks at all times, then it is evident we must solve the problem in quite a different manner. Take, for instance, a case where there is already installed a plant of 200 kw.; the output varies from 1,500 to 2,500 units per day of 20 hours, and the maximum demand is 400 kw. Then, if we put a battery in with an output of 200 kw. for a short time, its maximum power added to the generator's maximum will give the required maximum demanded for the feeders. But if we attempt to run the generator at constant full load all the time, it will give off 4,000 units per day, and this will provide a large surplus at all times for boiling up the battery. The difficulty can be met by putting the machine to do only half load, but in this case the combination does not give out the 400 kw. needed to meet the heavy peaks which come on at intervals. Taking everything into consideration, then, it will be found that constant load on the generators can only be got in cases where the load is similar every day, and keeps on fairly regularly throughout the day, and where the size of the generator can be fixed so as to put out the proper amount of current every day at about full load. Of course, in many cases, a good deal can be done by varying the number of hours that the generator is run, so as to provide just the number of units required to meet the load and to keep the battery properly charged.

Properties of Booster.—For a general solution of the problem the booster should have very flexible properties. It should, indeed, fulfill the following requirements:

1. When required, it should work so as to keep the load on the generator approximately steady. This will be needed when the demand for current is approximately equal to the output of the generator. In this case, however, when a very heavy demand is made on the feeders, both generator and battery current should rise to meet it, so that the utmost power of the combination will be available. If this be not arranged, it will often be found that a heavy load will blow first one circuit and then the other, although

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[*] Paper read at the meeting of the Newcastle Section of the British Institution of Electrical Engineers, December 12, 1904.

the combined maximum power of the battery and generator would have sufficient to meet the demand had the booster been arranged to allow the generator output to increase along with the battery's output.

2. It should be possible to vary the apportionment of the load between the battery and generator. In a slack time the battery should do very little. Also, if the traction peak should correspond with the lighting peak, then it may be desirable to let the battery take an extra load to relieve the boilers for the time being.

3. On a slack day with occasional peaks the battery and booster combination should be arranged to respond to the peaks only, and otherwise do practically nothing, so as not to overcharge the battery. Sometimes the booster may be cut out altogether, and the battery may then with advantage be used to float on the line to meet any occasional rush of current.

4. For periods of very light load, the booster and battery should be arranged to go on to the bus bars without any generator. In this case the booster should be arranged to compound up to counteract the drop of volts in the battery.

I might point out that a booster worked by the feeder currents only will not fulfill these requirements, as such a combination will tend to take the load off the generator when the battery is fully charged, while it will be sluggish and unresponsive when the battery is down at all in volts.

(To be continued.)

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The Institute's Annual Dinner.

The annual dinner of the American Institute of Electrical Engineers will be given in the ballroom of the Waldorf Astoria, New York City, on February 8, and promises to be a most interesting occasion. In view of the recent opening of the Subway, thus adding underground traction in America to the domain of electricity; the adoption of electric locomotives for their great Manhattan terminal divisions by the New York Central and Pennsylvania Railroads, the equipment of the Long Island Railroad with electricity, and other signal events, the Institute has decided to devote this dinner to emphasizing the triumph of electric traction. A number of pioneers and leaders will be present. An original menu has been designed, and some novel features will be introduced, while the list of speakers includes men of national and international reputation. The dinner will be served for $5 per cover without wine or cigars, and as is usual on these occasions ladies will be present. The participation of the ladies was a feature that elicited Mr. Carnegie'e enthusiastic commendation at the famous Institute Library dinner, which he made forever memorable by his million dollar gift for the United Engineering Building. Notices will be sent to the members forthwith, and it is requested that an early response be made, in order that proper care can be taken of all applications. Over 400 had to be seated at the Edison dinner last year, and the attendance in February promises to be equally large.

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Proposals Invited.

The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until January 24, for furnishing the navy yards at Boston, Portsmouth, New York, League Island, Norfolk, Washington, and elsewhere, with the following: Schedule 33, arc lamps and electrical supplies; schedule 34, incandescent lamps, wire and cable, conduit and fittings, buzzers, Weston ammeters, armatures, circuit breakers, telegraphs and indicators, bracket fans, LeClanche battery cells, thermostats, carbons, fuses, and miscellaneous electrical supplies; schedule 36, electrical supplies; schedule 37, motors. Proposal blanks will be furnished upon application to the navy pay offices in the above-mentioned cities or to the Bureau. Applications should designate the schedules desired by number.

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ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JAN. 3, 1905.

Electric Railways and Appliances.

778,933. Trolley Catcher and Retriever. Charles F. Wilson, New York City. Filed Aug. 19, 1903.

778,958. Electrical Door-Releasing Device. Frank M. Edmons, Holyoke, Mass., assignor to the Coburn Trolley Track Manufacturing Company, Holyoke, Mass. Filed March 27, 1903.

778,987. Trolley. William W. Mercer, Norfolk, Va., assignor of one half to Benjamin J. Cady, Washington, D. C. Filed May 28, 1904.

779,075. Block System. Antonio Fiorini, Pontremoli, Italy. Filed April 13, 1904.

779,150. Third-Rail System. Giosue D'Esposito, Pittsburg, Pa., assignor of one-half to Stuart Patterson, same place. Filed March 12, 1904.

779,204. Electric-Railway System. George L. Campbell, Nyack, N. Y., assignor to the American Construction Company. Filed Oct. 11, 1902. Renewed July 8, 1904.

779,390. Signaling for Railways. William S. Berry, Pittsburg, Pa. Filed May 25, 1903.

779,401. Trolley-Pole Controller. Arthur W. Harrison, and Eugene H. Fosdick, Los Angeles, Cal. Filed June 2, 1904.

Electric Lights and Appliances.

778,913. Rheostat for Electric-Arc Lamps. Bernard A. Stowe, Cleveland, O., assignor to the Jandus Electric Company. Filed Oct. 28, 1903.

778,914-915. Electric-Arc Lamp. Bernard A. Stowe, Cleveland, O., assignor to the Jandus Electric Company Filed April 30 and May 19, 1904.

778,984. Electric-Lamp Bracket. Edwin H. Lux, Logansport, Ind. Filed June 10, 1904.

Electrical Machinery and Apparatus.

778,834. Means for Ventilating Electrical Machines. Albert Aichele, Baden, Switzerland, assignor to the firm of Actiengesellschaft Brown, Boveri & Co., same place. Filed Dec. 7, 1903.

778,897. Motor Control for Hoisting-Buckets. Lewis J. Robb and William M. Rosewater, Pittsburg, Pa., assignors to Heyl & Patterson, same place. Filed Dec. 19, 1903.

779,098. Electric Plug. Nelson H. Raymond, Brooklyn, N. Y., assignor to Stanley & Patterson, New York City. Filed April 13, 1904.

779,182. Combined Circuit-Breaker and Starting Rheostat. Robert H. Read, Schenectady, N. Y., assignor to the General Electric Company. Filed Oct. 28, 1903.

779,189. Power-Generating Apparatus. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed April 12, 1900.

779,190. Static-Influence Electrical Machine. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed April 12, 1903.

779,199. Motor-Controller. Charles E. Barry, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 24, 1903. Renewed May 21, 1904.

779,206. Control System. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 24, 1903.

779,249. Time-Circuit Controlling Apparatus. Johan M. Andersen, Boston, Mass., assignor of one-half to Albert Anderson, same place. Filed Dec. 14, 1903.

779,255. Current-Meter. Warren S. Blauvelt, Grosse Isle, Mich. Filed July 18, 1904.

779,265. Brush-Holder for Dynamo-Electric Machines. Fredrick M. Conlee, Madison, Wis., assignor to the Northern Electrical Manufacturing Company. Filed May 21, 1904.

779,267. Current-Controlling System. Arthur C. Eastwood, Cleveland, O. Filed Aug. 9, 1904.

779,320. Current-Motor. Gilbert Samuelson, Sandpoint, Idaho, assignor of one-half to Edward McGregor, same place. Filed March 26, 1904.

779,376. Automatic Magnetic Circuit-Breaker. William M. Scott, Philadelphia, Pa., assignor to the Cutter Electrical & Manfacturing Company. Filed May 27, 1899. Renewed Dec. 11, 1901.

Telephones and Telephone Apparatus.

778,877. Telephony. Albert Meinema, Chicago, Ill. Filed May 2, 1904.

779,004. Multiple-Transfer Switchboard. Charles B. Smith, New York City. Filed May 8, 1900.

Miscellaneous.

778,893. Galvanic Battery. Charles J. Reed, Philadelphia, Pa., assignor to the Security Investment Company. Filed July 12, 1901.

778,894. Process of Making Spongy Lead for Secondary-Battery Electrodes. Charles J. Reed, Philadelphia, Pa., assignor to the Security Investment Company. Filed May 7, 1903.

778,912. Dry Cell. Walther Stockigt, Greiz, Germany, Filed May 12, 1904.

778,971. Electric Burglar-Alarm. Franklin S. Holmes, New York City. Filed May 17, 1904.

779,003. Automatic Magnetic Circuit-Breaker. William M. Scott, Philadelphia, Pa., assignor to the Cutter Electrical & Manufacturing Company. Filed June 28, 1901.

779,054. Electric Generating Unit. Sterling Shaw, Jacksonville, Ill. Filed Aug. 29, 1899.

779,090. Thermo-Electric Element. Albert L. Marsh, Lake Bluff, Ill., assignor to William A. Spinks & Co., Chicago, Ill., a copartnership. Filed June 4, 1904.

779,153. Apparatus for Perforating the Type-Bands for Automatic Telegraph Transmitting Apparatus or the Like. Adolf Franke, Gross-Lichterfelde, and Erwin Ehrhardt, Berlin, Germany, assignors to Siemens & Halske, Aktien-Gesellschaft, same place. Filed Feb. 29, 1904.

779,223. Keyboard Telegraphic Transmitter. Maximilien Kotyra, Paris, France. Filed March 21, 1904.

779,231. Induction-Coil. John G. Meyers, East Providence, R. I., assignor to the Varley Duplex Magnet Company, Phillipsdale, R. I. Filed Aug. 4, 1904.

779,247. Apparatus for Testing Electrical Resistances. John B. West and Frederick M. Du Bois, Syracuse, N. Y., said Du Bois assignor to said West. Filed Jan. 2, 1904.

779,383-384. Electrolytic Apparatus and Process. Clinton P. Townsend, Washington, D. C. Original application filed April 12, 1902. Divided and this application filed May 10 and May 11, 1904.

Reissue.

12,301. Process of Electrolytically Refining Lead. Anson G. Betts, Lansingburg, N. Y. Filed April 23, 1903. Original No. 713,277, dated Nov. 11, 1902.

THE TELEPHONE WORLD.

Southwestern Missouri Independent Telephone Association Organized.

Representatives of Independent lines in the southwestern part of Missouri and the northwestern part of Arkansas met in Neosho, Mo., a short time ago and organized the Southwestern Missouri Independent Telephone Association. The following officers were elected: President, C. M. Robeson, Neosho; secretary, Dr. J. B. Hancock, Newtonia. Among those present were W. T. Stahl, Siloam Springs; J. I. Potter, Gravette; K. G. Comfort, Westville; W. D. Wessons, Springtown, and others.

Successful Indiana Company.

At the annual meeting of the stockholders of the Ft. Wayne, Ind., Home Telephone Company, the following officers and directors were elected for the ensuing year: President, Charles S. Bash; vice-president, John B. Reuss. secretary and manager, William L. Moellering; treasurer, Max B. Fisher; Charles S. Bash, J. B. Reuss, W. L. Moellering, M. B. Fisher, Isador Lehman, P. W. Smith, G. Max Hoffman, W. A. Bohn and George L. Fox, directors.

The annual reports, showed the end of the most prosperous fiscal year in the company's history. At the meeting 4,561 shares of stock out of 5,000 shares were represented. The stock is distributed among 127 persons, all but two of whom are residents of Ft: Wayne.

The report of the secretary showed 3,220 telephones in operation, a gain of 400 over last year. New telephones are being installed now at the rate of 50 per month. Upon the Home lines are more than 1,000 business houses in Ft. Wayne. The company now has nearly 200,000 feet of underground and aerial cable in service, and 25,000 feet has been added during the past year. It is the intention of the company to expend $15,000 in cable extensions and farm lines within the next six months.

Owing to the death of Judge James M. Thomas, the Portsmouth, O., Telephone Company has been reorganized by the election of the following officers: President, I. S. Grimes; vice-president, Joseph S. McKell, Chillicothe; secretary and treasurer, Dr. W. D. Temper; general manager, E. E. Knox.

The Citizens' Telephone Company, which has already a large number of subscribers in Meredith, N. H., will extend its lines to Meredith Neck in the spring and it is probable that a central office will be located in Meredith.

George W. Beers, of Ft. Wayne, Ind., has bought the Leavenworth, Kan., telephone plant. It has 700 subscribers and two toll lines, 26 miles long. Mr. Beers will at once modernize the plant at a cost of $150,000.

Since the incorporation of the Independent Telephone Company at Council Bluffs, Ia., a number of companies have signified their intention of making extensions to connect with the new system when it is established.

The president of the New Telephone Company of Indianapolis, Ind., has ordered plans for the erection of a new exchange building.

Independents Unite with Eastern Traffic Association.

Representatives of the Independent long-distance concerns in Western Pennsylvania, West Virginia and Maryland recently met in Cumberland, Md., and voted unanimously to join the Eastern Traffic Association of Independent Telephone Companies.

The accession at Cumberland means another link westward in the first attempt of the Independent people to give a transcontinental, or what might be termed interstate long-distance service in competition with the Bell Company. As a result of the new move, the long distance service of all the lines concerned will be controlled for an interchange of business; a uniform rate of charges will be established, and a uniform standardization of the system perfected. All money for long distance service beyond the territory of the respective lines will be forwarded to the proper exchanging companies, and in many ways an improved and enlarged service will be made possible.

Nebraska Independents to Meet.

The regular annual meeting of the Nebraska Independent Telephone Association will be held at Lincoln January 18 and 19. E. C. Hansen, of Fairbury, Neb., is secretary, and urges all Independents to attend.

The Farmers' Fountain Telephone Company was organized lately in Waterloo, Ill., and will soon begin the work of constructing three lines of 20 telephones each, all on one wire. The farmers will construct the line, and then divide the expenses among themselves. The cost of maintenance will be prorated. New Hanover is to be the central exchange for all these lines. Waterloo, Columbia and New Hanover will be the three towns connected by the lines. It is probable that the lines will be extended throughout Monroe County, should the system prove successful.

The farmers in Ponoco precinct, Saunders County, Neb., who want telephones have closed arrangements for connection with the lines of the Fremont Telephone Company. They are to put in their own instruments and set the poles and furnish the wires. The installing is to be done by the Fremont Company. The northeastern part of Saunders County has heretofore been without telephone communication with the towns and is tributary to Fremont.

A number of the leading financiers and telephone men of Lincoln, Neb., have been discussing the project of a new independent telephone line, which, if carried to completion, will take in Sioux City, Omaha. Lincoln and Denver. M. H. Spere, of the El Paso Telephone Company, and a promoter of several other lines, have been talking the matter over.

The Consolidated Telephone Company has completed its line to Lebanon, Pa. This gives the company direct connection to that place and Harrisburg. Arrangements are being made to build a line from Pottsville to Hamburg. This will give the Reading exchange a new outlet to the northern coal fields.

Youngstown Company Makes Extensions.

The Youngstown, O., Telephone Company has completed several important extensions to its local telephone service which puts it in a way to give its patrons better service than ever before. The new lines have been put up to Sharon and Greenville of No. 10 copper metallic circuits. A private branch exchange has been put into the office of the Youngstown & Sharon Railway Company, and a deal has been closed for a private line to the Bessemer limestone quarries near Lowellville. About 10 stations are attached through the exchange in the Youngstown & Sharon office.

During last year the Youngstown Telephone Company has put in 800 new telephones, that number being about evenly divided between business houses and private houses. Quite a number of farm lines have been put in and several toll lines have been added to the former list. The latter included one to Canfield. The new Sharon and Greenville lines give direct connection from Youngstown to many towns in Western Pennsylvania and New York State. Men are now at work on a new line along the Salt Springs road, which will connect several farm houses with the local exchange. The company closed last year with a total of not less than 3,000 telephones in its Youngstown district.

More Rural Telephone Lines.

A regular network of telephone lines is being constructed in the southern part of Bourbon and Crawford Counties, Kan.

Seventeen rural 'phone lines now run to the town of McCune from every point of the compass. The latest line has just been completed. Two additional lines will be constructed north and west from McCune in the near future.

The telephone company which was organized in the Buzz corner neighborhood in Sheridan Township of Crawford County, will run a line of poles to Cherokee, instead of putting the wire on the poles of the No. 1 line.

Two new telephone lines from Arcadia to Englevale. one running west, the other south by Coalvale are being worked up. The new line from Drywood is headed toward Pawnee.

A new line will soon be in operation between Arcadia and Harrisburg. Another line is being constructed from Arcadia to Girard and Swarts.

The Greenbush-Walnut Telephone line was lately brought into Walnut and connected with central. The line extends from Walnut to Greenbush and McCune, with exchange privileges on the St. Paul line.

The Central Union Telephone Company is laying a cable across the Illinois River at Beardstown, Ill.

The Wisconsin Independent Telephone Association will hold its meeting in Milwaukee January 25-26.

Telephone Incorporations.

The Clay County Telephone Company, Montpelier, Miss. Capital stock, $1,000.

The Howardsville Telephone Company, Lena, Ill. Capital stock, $2,500. Incorporators: Edward Fisher, G. W. Davis and E. A. Howard.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Camden, O.—The Camden electric light plant and all stock has been sold to E. C. Eikenberry for a consideration of $3,000.

Chariton, Ia.—The city council will rebuild the electric light plant at a cost of $40,000.

Clayton, Ind.—The Clayton Milling Company has purchased the Cloverdale electric light plant and will remove it to this city.

Edgar, Neb.—Keefe & Larkin have secured a franchise for lighting this city with electricity. A new plant will be constructed.

Forsyth, Mont.—The council has let the contract to J. E. Edwards for lighting the town for a period of 20 years, at a cost of $1.20 per year for each light.

Green Bay, Wis.—The county asylum trustees have planned to install an electric lighting plant in the asylum.

Houston, Miss.—It is reported that this town is considering the erection of an electric light plant. The town clerk can be addressed.

Ironton, O.—The installation of an electric lighting plant at the city waterworks is being considered by the board of public service.

Jonesboro, Ark.—It is proposed by J. F. Gautney to construct an electric plant for the transmission of electricity, a distance of 100 miles, for lighting railways and other purposes.

Leon, Ia.—Curtis & Chase, the new owners of the electric light plant, will have it inspected by an engineer, with a view to overhauling and improving it.

Little Rock, Ark.—The installation of an electric light plant is said to be contemplated by the Retail Grocers' Ice Company.

Madisonville, Ky.—A new electric light plant is proposed. Henry Oliver, of Fulton, is at the head of the enterprise.

McComb, Miss.—The McComb City Electric Light & Power Company with a capital of $50,000, has been incorporated.

Mendota, Ill.—An electric light plant, owned by Lathrop & Fahler, was lately destroyed by fire.

Mexico, City, Mex.—Considerable improvements are being made in the electric light plant. George Weddill is general manager.

Milwaukee, Wis.—Bonds will be set aside for the erection of a $400,000 electric light plant for this city.

Piedmont, Mo.—The electric light plant at this place was recently destroyed by fire.

Reinbeck, Ia.—Henry Nissen contemplates enlarging his electric light plant, and adding another dynamo.

Rising Sun, O.—The city council has granted a franchise to A. C. McMillen to build and operate an electric light plant here.

Saugatuck, Mich.—The Saugatuck Light & Power Company is to be incorporated by Charles A. Floyd and B. Van Raulto, of Holland, to establish an electric light and gas plant here.

Savannah, Ga.—This city has under consideration the erection of an electric light plant. Address the mayor.

South Bend, Ind.—The electric light plant was damaged by the blizzard last week to the extent of $2,000.

Washington, Pa.—The Washington Electric Light & Power Company on January 1 reduced the rate for domestic light one-third.

Zionsville, Ind.—An effort is being made by a number of enterprising citizens of this place to establish an electric light plant here.

STREET RAILWAYS.

Bloomington, Ill.—The Springfield, Lincoln, Bloomington, Pekin & Peoria Electric Railway Company, of this city, has changed its name to the Springfield & Northwestern Railway Company. Its capital is increased from $300,000 to $900,000.

Brownsville, Tenn.—A franchise has been granted to resident parties of this city for installing an electric car system here

Chillicothe, O.—The county commissioners have granted the Springfield, Washington C. H. & Chillicothe Traction Company a franchise.

Cleveland, O.—Myron H. Wilson, treasurer of the Cleveland Trust Company and Jacob H. Schmidlapp, president of the Cincinnati Union Trust Company, have been appointed receivers of the Central Market Street Railway Company of Columbus, O., the Dayton, Springfield & Urbana Electric Company and the Columbus, London & Springfield Street Railway Company, all owned by Arthur E. Appleyard, of Boston. The receivers were appointed with the consent of the companies.

Durand, Wis.—There is talk at Rock Elm of a trolley line to be built from this city to Ellsworth, passing through the former place.

Fort Smith, Ark.—It is reported that the Fort Smith Electric Street Railway Company contemplates expending $180,000 in improvements, including the erection of a power house.

Huntington, Ind.—The Huntington, Columbia City & Northwestern Railway Company has been incorporated with a capital stock of $25,000. The line will be run from this city through six cities to Lagrange.

Newark, N. J.—Judge William M. Lanning, of the United States District Court, has appointed Edwin C. Foster receiver for the New Orleans Railways Company. The application was made on behalf of the New York Security & Trust Company.

New Haven, Conn.—The sale of the New York & Stamford Electric Railroad to the New York, New Haven & Hartford Railroad Company for $1,000,000 is officially confirmed.

Niles, Mich.—F. M. Gray, a capitalist of this city, has started a movement to form a company and build an electric line west from Buchanan to Michigan City, Ind.

Wichita, Kan.—The Wichita Railroad & Light Company has decided to enlarge its power house and plant to over twice its present capacity.

POWER PLANTS.

Canton, N. Y.—The St. Lawrence Transmission Company has been incorporated with the Secretary of State, to generate, buy, sell, transmit, use and deal in electricity for producing light, heat or power; also to carry on the business of lighting by electricity or using it for heat or power in various localities. The capital stock is $25,000. It is proposed to carry on operations in the towns of Massena, Louisville, Norfolk, Waddington, Madrid, Norwood, Potsdam, Canton, Rensselaer Falls. Heuvelton, Richville. Hermon, Morristown, Gouverneur, Edwards and Talcville, and the city of Ogdensburg, all in St. Lawrence County.

Lockhart, S. C.—The Broad River Light & Power Company has been incorporated with a capital of $1,000,000 by J. L. Davis, M. V. Haselden and others, to develop power in this place.

Manitowoc, Wis.—Work will be started at once on a $200,000 electric plant for furnishing power and heat, the West Side Electric Company, of which Mayor William Bahr is head, having been granted a franchise.

Pittsfield, Mass.—The Pittsfield Street Railway Company is to build during next season a power plant. Its growth and development of new lines necessitate a plant of its own.

BIDS WANTED.

Little Rock, Ark.—Sealed proposals will be received by the board of public affairs for this city until 12 o'clock noon, January 18, for the building of an addition to the city electric light building according to the plans and specifications on file in the office of the superintendent of public works, at the city hall, and the erecting and installing of a 350 hp. boiler and equipment, according to plans and specifications on file in the office of the city electrician at the city electric plant, same to be paid in city warrants, one-half cash, upon completion and acceptance of the work, and one-half due July 25, 1905. The board reserves the right to reject any or all bids. Address Board of Public Affairs, care of F. M. Oliver, Clerk.

Birmingham, Ala.—The Kennedy Stave & Cooperage Company, of this city, is in the market for a 14 by 20 automatic engine, and two 72 inch by 16 foot tubular boilers.

Carrollton, Ga.—The Carrollton Electric Company, of which J. G. Cheney is secretary and treasurer, wants a 40 to 50 hp. engine.

Cumberland, Md.—The Footers' Dye Works here is in the market for power, electrical equipment and supplies.

Dawson, Ga.—A. J. Baldwin & Co., 102-4 Main street, this city, is in the market for a new or second-hand Corliss engine, 14 by 42 inches.

Hattiesburg, Miss.—The People's Ice & Coal Company of this city wants one 200 hp. Scotch marine boiler.

Lebanon, Va.—L. L. Bays & Sons, of this city, are in the market for electric lighting apparatus.

Mount Olive, N. C.—The Bell Lumber Company of this place wants prices on a new and second-hand 60 hp engine, and 80 hp. boiler.

Neck, Mo.—The North Fork Lead & Zinc Company want prices on a 100 hp. boiler. Address Jesse Roberts, general manager, Lock Box 23, this city.

Newcastle, Pa.—The Sample Agency Company, 20 Pittsburg street, is in the market for one 100 hp. engine (reversible), and one 150 hp. boiler; also a gasoline engine.

Wheeling, W. Va.—Henry Schmulbach, of his city, wants prices on generators.

NCTES FOR INVESTCRS.

Latest quotations for copper are: Electrolytic, 15@15¼c.; Lake 1⅜⅛@15⅜c.; casting, 14¾@15c.

An increase in the dividend rate on Electric Company of America (Philadelphia) is looked for at the meeting of directors this week.

Mayor McClellan asserts that New York city will build its own lighting plant whether or not the Legislature passes the city lighting bill.

At the annual meeting of the Boston & Lowell Railroad Corporation the stockholders re-elected the directors and approved an issue of $500,000 bonds.

The Omaha Electric Light & Power Company has declared the regular semi-annual dividend of $2.50 per share, payable February 1 to stockholders of record January 20.

The State Department at Harrisburg, Pa., has granted a charter to the Commonwealth Electric Company of Philadelphia, with a capital of $100,000 to furnish light, heat and power to the city of Philadelphia.

Philadelphia Electric shares were adversely effected by the chartering of the Commonwealth Electric Company, and Philadelphia Electric is now 10 per cent. below the high price two weeks ago.

W. J. Ferris, of the General Electric Company, has purchased the plant of the Independent Light & Power Company of Quincy, Ill., from J. W. Cassidy. The price paid was about $200,000.

The New Haven Railroad pays $1,000,000 or $125 per share in 4 per cent. bonds of the Consolidated Railway Company for 8,000 shares of the New York & Stamford Electric Railway Company.

A $5,000,000 mortgage given by the Niagara, Lockport & Ontario Power Company in favor of the Standard Trust Company of New York was placed on record in the county clerk's office in Lockport, N. Y., last week.

The presence in this city of J. J. Mitchell, president of the Illinois Trust Company, and important members of the Chicago group interested in the Chicago Union Traction Company, is expected to lead to important conferences with the Eastern interests of the company, represented by H. B. Hollins & Co., looking to settlement of the Chicago traction tangle.

It is stated that the United Electric & Power Company of Baltimore has purchased from Berton, Storrs & Griscom, of New York, a majority of the stock of the Consolidated Gas Company of Baltimore. This is the first step in the plan which contemplates a consolidation of the United Electric Light & Power Company and the Consolidated Gas Company. It is thought that the total capitalization of the reorganized company will exceed $30,000,000.

The decline in New York Metropolitan stock is a matter of poor earnings. The last nine days in December the subway carried 318,000 passengers daily, and in the same time the Manhattan Elevated traffic fell off 40,000 passengers per day. This leaves 278,000 passengers to come from somewhere. The question now rises how much traffic must Metropolitan be losing? More subways are to come. The new Interborough City Railway Company has obtained a charter to build six trolleys in the Bronx, and will do business on transfer to existing subway lines at 8 cents per passenger. Thus it looks as if money expended by the Metropolitan in the Bronx district will, for some time to come at least, be an unprofitable investment.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Jan. 9.
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	168½
Metropolitan Street Railway	114½
Metropolitan Securities	73½
Ninth Avenue	197
Third Avenue	131
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	60
Interborough Rapid Transit	177¼
New Orleans Railway	2¾
Public Service Corporation (New Jersey)	138
Philadelphia.	
Consolidated Traction of New Jersey	79½
Philadelphia Traction	99¼
Union Traction	58⅞
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	13½
do. do. do. pref.	58¼
West End Street, com	95
do. do. do. pref.	113
Chicago.	
City Railway	186
North Chicago	87½
Union Traction, com	10
do. do. pref.	39½
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	16
do. pref.	65¾
Electric Boat, com	40
do. do. pref.	85
Electric Lead Reduction	¼
Electric Vehicle, com	12
do. do. pref.	23
Westinghouse, com	179
do. pref.	195
General Electric	186¼
Boston.	
Edison Electric Illuminating	252
General Electric	186¼
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	48
do. do. pref.	109
Philadelphia.	
Electric Company of America	11¼
Electric Storage Battery, com	79
do. do. do. pref.	79
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	146⅜
Western Telephone Company	20
New England Telephone Company	139
New York.	
American Telegraph & Cable Company	93¼
Commercial Cable Company	210¼
Mexican Telephone Company	2
New York & New Jersey Telephone Company	158¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93
Chicago Telephone Company	44¾
MISCELLANEOUS STOCKS.	
Otis Elevator Company	50
Consolidated Car Heating	64
Standard Underground Cable	200

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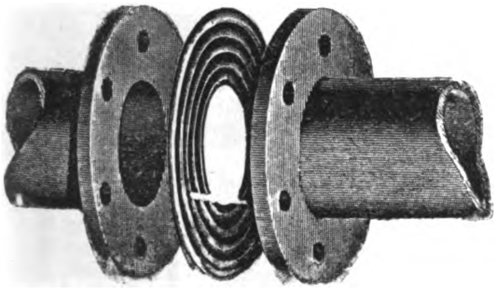

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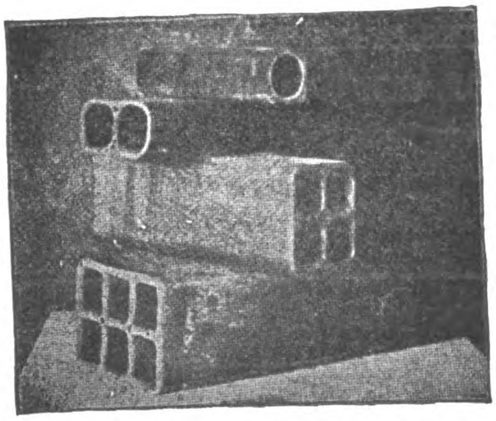

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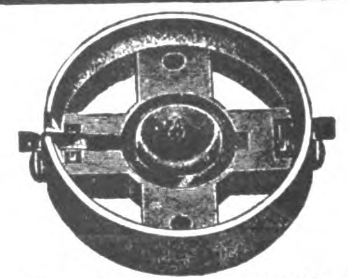

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ELECTRICITY.

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EDITORIAL NOTES.

Why Brooklyn Bridge Must be Rebuilt.

An original investment of $15,000,000, which, with attention and care, has reached $20,000,000, represents the money spent on Brooklyn Bridge. Once the pride of the metropolis and the wonder of the world it is now reaching a period in its history when the paramount question of danger overrides all other considerations and the structure must be rebuilt to insure public confidence and safety. Its rate of deterioration has been $1,000,000 a year, which the engineering experts have attributed to the causes of overstrain and electrolysis. Overstrain perhaps was to have been expected of the only direct connecting link between two great cities; but electrolysis as a cause of destruction to so noble a structure represents a certain knowing heedlessness on the part of trolley companies whose experiences should have called for some provision on their part against such disastrous consequences. Let means be taken to prevent similar destruction of the new bridges further up the river.

* * *

Coal Combustion for Gas and Steam Plants.

Theories tickle the imagination, but facts produce a healthier stimulation of the faculties. In theory a gas engine electric light plant is ideal, but the question is often asked, How is it in practice?

Here are the facts: Two electric plants were compared, one operated by gas of 685 hp., the other by steam of 1,250 hp. capacity respectively. Each plant ran from 15 to 18 hours a day. The statistics at hand after a six months' run show a heat consumption for the steam plant of 92,000 British Thermal Units per kilowatt hour and for the gas plant a heat consumption of only 29,100 B. T. U. per kilowatt hour. This shows a reduction comparatively to nearly one-third—the ratio of 29,100 to 92,000. In the instance recorded the coal from which the gas was obtained averaged up about 13,000 B.T.U. per pound. The richer the coal in heat units the less the weight required per kilowatt hour and the cheaper, comparatively, the power produced.

The startling results shown in this test are the strongest possible advocates for a radical change in power-producing methods—particularly those employed for the production of cheap electricity. Where plants are to be installed near fuel centers no argument against a gas installation is possible. It is only when installations are far away from coal fields that the cost of coal reduces the significance of the foregoing results.

* * *

Does the Public Buy Light or Electricity?

The agitation of questions of general public interest has been the means of awakening public consciousness to the true meaning of certain technical situations—the result of which has been, in most instances, an improvement, in an economical or financial sense, of great public benefit.

The desires of municipal leaders are not always in harmony with the expressed opinion of the public. As advisers the municipal representatives may be correct, but much of their influence as public benefactors depends upon the various phases of the subject which can be presented by argumentative antagonists as a means of overruling such suggestions.

Such a condition of affairs presents itself in those cases where the public buy electricity for electric lighting and are supplied with lamps to use this energy, and find, when it is so utilized, the lamps do not give their proper quota of light.

This is not the situation in large American cities, but it is often the case in small towns, thousands of which enjoy the advantages springing from the use of electricity for light and power. The question naturally arises in relation to such cases where power is received after covering considerable distance, whether the sale of electricity for lighting ought not, for the protection of customers, be best considered as the sale of *light*. What a man actually buys or wants to procure when he uses electricity is not the electricity itself but light. This, therefore, is a basis which would yield better returns to both parties in the end than the practice now observed, for obvious reasons.

These reasons are as follows: First, the public want the light—just the same as the city lighting is contracted, on the basis of a given amount of light for a given period of time; second, the lighting companies are at liberty to choose the lamp they please for generating light. This, of course, gives them considerable freedom, because if they employ a lamp which takes less power and gives the same light, they make more profit on the sale of power.

If it were now possible for a lighting corporation to introduce successfully, for general use, a two watt lamp instead of a three and a half or three watt per candle power, the capacity of the plant would be directly increased one-third, without any greater increase in expense other than that required for the installation of services to the new points of consumption.

Perhaps the future will show that the sale of light is the most logical and unquestionably the most modern course for the lighting companies to follow. While it might be argued that it amounts to the same thing in the end, yet, under such circumstances as those suggested, the necessity imposed upon lighting companies to devote their interest equally to the production of cheap power as well as cheap light would lead to the invention of a practical low watt lamp. Legislative enactment may limit the cost of electricity, but progress in the field of new sources of illumination will make such laws futile, at least in so far as cheap light is concerned.

* * *

Mont Blanc's Electric Railway. An electric railway to take passengers to the top of Mont Blanc, the highest mountain of the Alps, will be built by a company formed in Paris. The estimated cost of the road is $2,000,000, and a cable dispatch says the money was all paid in by the stock subscribers last week. The engineers have made plans to obtain the necessary electrical energy from some of the numerous waterfalls to be found in the locality. Instead of paying $60 for the services of guides to make the ascent, the cost for the trip on the electric railway will be only $10.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Chicago is credited with selling $13,000,000 worth of electrical apparatus last year.

Comptroller Grout of this city has engaged several electrical experts to assist him in his investigation into the cost of electric lighting supplied to New York.

The Faraday Society of Great Britain is to be congratulated on having Lord Kelvin for its next president.

The Allis-Chalmers Company is "gathering in" a number of brainy men from the big electrical companies.

The Young Men's Christian Association of Boston last week opened a school of applied electricity. Mr. William Smith, formerly of the Massachusetts Institute of Technology teaching staff, will deliver a series of lectures.

United States Consul Bliss at Venice informs the State Department that there is a great demand in that city for electric launches and electric appliances.

It is stated in Pittsfield, Mass., dispatches that the Stanley Electrical Company of Pittsfield and the General Incandescent Arc Light Company of New York have been consolidated.

Arrangements are being made for the installation of wireless telegraphy on the New York Central and Lake Shore railroads.

Judge Kavanagh of Chicago has appointed Edward Bemmer receiver for the Whitney Electrical Company, which is capitalized for $56,000,000, to promote the alleged inventions of Albert Gallatin Whitney. His bond was fixed at $500. The petitioners allege the assets principally consist of "mythical plans and absurd inventions." One of the inventions, it is alleged, consists in "ejecting or shooting above and beyond the atmosphere of the planet commonly known as the earth four brass balls, which are supposed to gently and peaceably remain beyond said atmosphere after having been once shot or thrown up there."

The French Government is experimenting with a telautograph for the purpose of its adoption throughout France. The instrument sends a telegraphic dispatch, reproducing at the receiving end the handwriting of the sender.

The 247th meeting of the New York Electrical Society will be held in the lecture room of the American Institute, 19 West 44th street, this (Wednesday) evening, January 18, at 8 o'clock. Prof. W. S. Franklin, of Lehigh University, will lecture on "Electric Waves and the Reaction of Transmission Lines." The elementary physical theory of electric wave motion will be outlined and the mechanical analogies carefully developed.

An attempt is to be made soon to dissipate fog in New York Harbor. The method to be followed will be precisely that which Sir Oliver Lodge has adopted in his successful fog-dispelling experiments at Birmingham University, England. The electric current is shot up into the fog through barbed wires. The current is of great intensity—250,000 volts.

A cable dispatch from Rome, Italy, says the greatest interest exists in scientific circles there over the invention of a system of wireless telephone by a monk, Father Emilio de Carbogagno of the Monastery of St. John and St. Paul. On a terrace in the monastery garden the inventor has placed four masts, forming the corners of a square, each side of which is 4 meters in length. A series of wires running down the sides of the masts are joined in a little box placed upon a table in the center. Hanging beside the box, which acts as a receiver for the voice, are two ordinary telephonic ear pieces. At a distance of 250 meters, another station, it is said a conversation can be readily carried on between the two stations.

Work on a wireless telegraph station in the Brooklyn Navy Yard will soon be begun to enable Commander Robert E. Peary to keep in touch with civilization during his next attempt to plant the flag at the pole. At the navy yard it is said Commander Peary will erect wireless stations after he leaves the Labrador coast, to keep in touch with the nearest station on the mainland as he proceeds northward. From there communication with New York will be easy. As announced, the vessel of the expedition will be forced to the northern coast of Grant Land, where the party will go into winter quarters. This is only about 450 miles from the pole.

UNITED ENGINEERING BUILDING.

At a meeting of the conference committee on the United Engineering Building, held January 7, Mr. Alfred R. Wolff was unanimously appointed consulting engineer for the heating and ventilation of both the United Engineering Building and the Engineers' Club, to be erected at 39th and 40th streets under the Carnegie gift to engineering of $1,500,000. Mr. C. O. Mailloux was selected as the consulting electrical engineer for the United Engineering Building, and the firm of Bates & Neilson were selected as consulting electrical engineers for the Engineers' Club. All these gentlemen are well known in connection with the execution of large work of the class named in New York and vicinity, in addition to which they are prominently identified with the organizations that will occupy the buildings in question. Mr. Wolff and Messrs. Bates & Neilson are also members of the Engineers' Club of some years' standing, and Mr. Putnam A. Bates was for a long time district engineer for all the Crocker-Wheeler installations in the New York territory.

Preparing for the Convention.

We are assured that nothing will be left undone by the committees having charge of the arrangements for the convention of the National Electric Light Association, which will be held in Denver and Colorado Springs the week of June 6. These committees, our correspondent states, have made such excellent progress that they are able already to assure those who are planning to attend the best treatment ever accorded a convention in Colorado.

Scores of means of entertaining the members and visitors have been suggested. There have been so many, in fact, that the committee was compelled to begin selecting and drop-seeking for the means to provide diversions. This is assurance of the arrangement for the best of everything.

Members of the association and others who will attend the convention have written to the secretary and to members of the committees their approval of the selection of the Colorado cities, because of the excellent pleasure trip that is afforded through attendance upon the convention.

Denver and Colorado Springs committees, our correspondent states, are both busily engaged in making their plans. They have arranged for many side trips already, and will see that a large number of others are in the itinerary. Each of these trips will be perfect in every detail.

Electricity Versus Gas.

The above heading is the title of a pamphlet just issued by the National Electric Light Association for the use of its members who are threatened with Welsbach competition for street lighting. This paper was originally written by Mr. W. F. White for the 1900 meeting of the Ohio Electric Light Association. Mr. White has practically rewritten the paper and has brought it down to date by adding data recently collected from cities and towns all over the country. The pamphlet is illustrated with reproductions from photography showing graphically the difference in street illumination by the two methods. It should prove of great value to the members of the association.

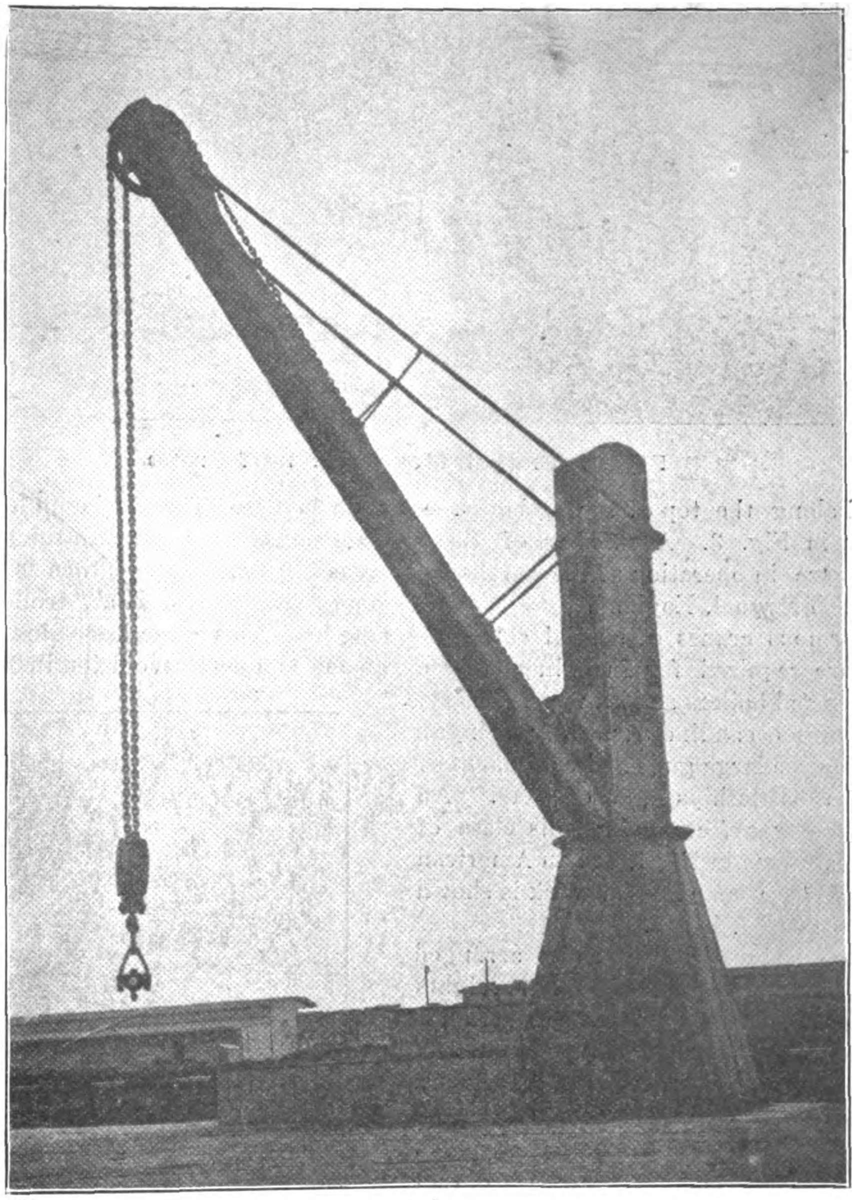

Fig. 1.—English Fixed Wharf Crane, 30 Tons Capacity.

MODERN HARBOR AND WHARF CRANES.

BY FRANK C. PERKINS.

Among the labor-saving devices utilized at the present day in the construction as well as for loading and discharging large vessels, none is more important than the wharf and harbor crane. Steam, hydraulic and electric power have been utilized extensively in Europe as well as in America for operating this class of machinery. In some cases the combination of electric power and hydraulic power is found most satisfactory. Fig. 1 shows a fixed hydraulic crane designed to lift 30 tons. It was erected at Rotterdam by Sir W. G. Armstrong, Whitworth & Co., while Fig. 2 illustrates a movable quay crane, constructed at the same works, having a pedestal with an opening through it large enough to allow men to pass with hand trucks. More than 100 of these cranes are in operation at the Royal Victoria & Albert Docks in London. Another type of movable hydraulic cranes, which greatly facilitates the loading and unloading of large vessels, is arranged to travel along the top of a warehouse, as shown in Fig. 3. A number of these cranes are in operation at the warehouse docks, Liverpool, England.

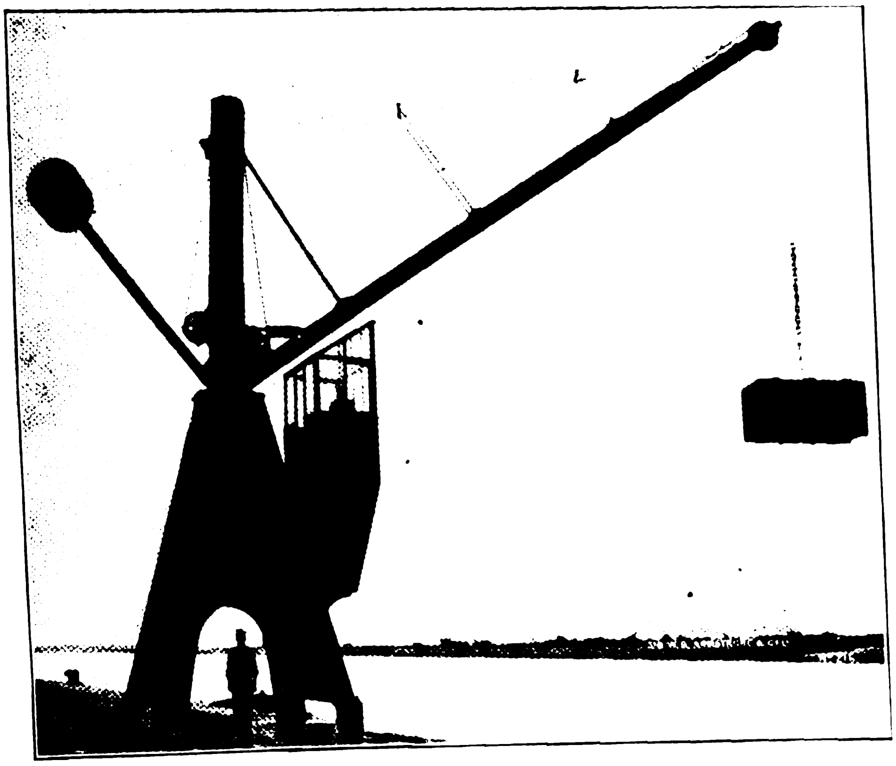

Fig. 2.—English Movable Wharf Crane.

Enormous cranes of special construction are required for installing marine engines and boilers and heavy machinery, in modern ocean liners and for placing in position the large guns and equipment of modern battleships and cruisers. An Austrian wharf crane for this class of work is shown in Fig 4, and an American crane for the same class of work is shown in the drawing, Fig. 5.

These heavy cranes are also arranged for a general loading of lighter weights at higher speeds. This latter function is of the greatest importance because as a general rule cranes built for heavy work will operate at a lower efficiency, and too slowly when used for lighter work, which forms the greater part of that carried on at an ordinary wharf. In busy shipyards cranes of the heavy type are not often required to move boilers and engines of from 50 to 150 tons weight and are therefore very often lying idle. The adaptability of these types of cranes to all kinds of work makes them unique and of special interest. The crane shown in Fig. 4 was constructed for the Steam Navigation Company of the Austrian Lloyd at Trieste by the Maschinenfabrik J. Von Petravic & Co., Vienna, Austria. This crane has a height of 34.14 meters at a maximum projection of 20.1 meters at the short jib with a load of from 35 to 170 tons and a maximum projection of 30.7 meters at the long jib with any load up to 35 tons. The maximum load of this crane on the short jib with the large trolley is 170 tons, while 50 tons is the maximum load for the small trolley on the long jib. This crane has a slowing speed of one complete revolution in 6 minutes, and all of the motions are obtained by a series wound electric motor. The maximum lifting speed of the small trolley is 3 meters per minute, the traveling speed being 20 meters per minute while the maximum speed of the large trolley is 8.5 meters per minute traveling, and .55 meters per minute for lifting, these speeds being for maximum loads while for smaller loads the speeds are proportionately faster.

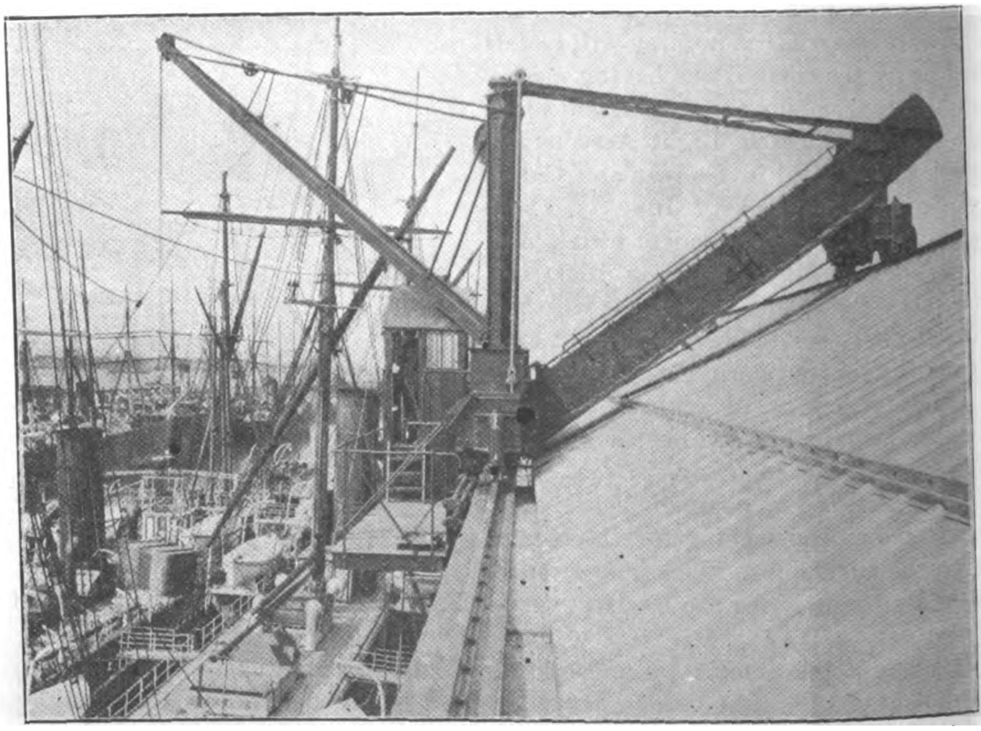

Fig. 3.—English Movable Hydraulic Crane.

The American folding jib crane of 75 tons capacity was installed by the Wellman-Siever Engineering Company of Cleveland, O., at the shipbuilding plant at Quincy, Mass., of the Fore River Ship & Engine Company.

This crane has a capacity of 56 tons for the main trolley, 28 tons for the auxiliary trolley and more than 11 tons for the lifting tackle. The longitudinal travel of this crane is operated at 57½ and 165 feet per minute, and the main trolley travels at the rate of 75 feet per minute, with a lift speed of 11 feet per minute. The auxiliary trolley has a lift speed of 22 feet per minute and a traveling speed of 150 feet per minute, while the lifting tackle operates at 25 feet per minute, and the boom hoist 21 feet per minute. This crane is utilized extensively in the fitting out of all classes of ships under construction in these yards, the storage yard being 1,200 feet in length and 150 feet in width. The fitting out dock, being 1,200 feet in length, will accommodate a number of large steamers, battleships and cruisers. The crane structure over the building slips is nearly 600 feet long and about 200 feet wide, with four high speed electric cranes in operation, each having a capacity of 10,000 pounds. Two of these cranes may be operated at the same time over each ship, with a total capacity of more than 10 tons.

Electric portal wharf cranes are extensivily employed in Germany and England as well as in the United States. The semi-portal electric crane is also utilized largely for loading and discharging vessels and are operated by steam and compressed air power as well as by electric power. The semi-portal or half portal electrically driven crane, noted in Fig. 6, was constructed by the Gesellschaft fur Elektrische Industrie of Karlsruhe, Germany, has a capacity of 4,000 kgs, with a range of 20 meters. The lifting speed is .50 meter per second a turning speed of 2 meters per second and a traveling speed of .25 meter per second.

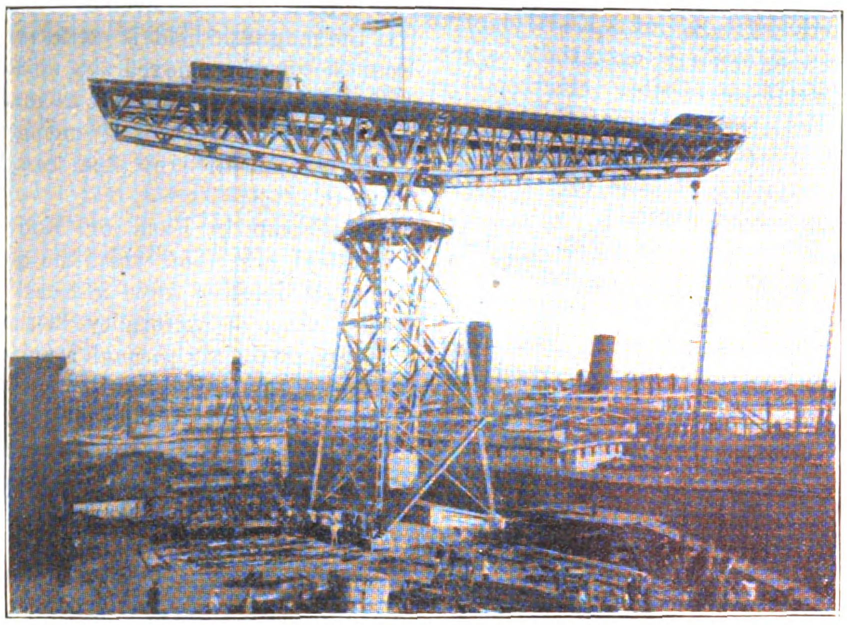
Fig. 4.—Austrian Wharf Crane.

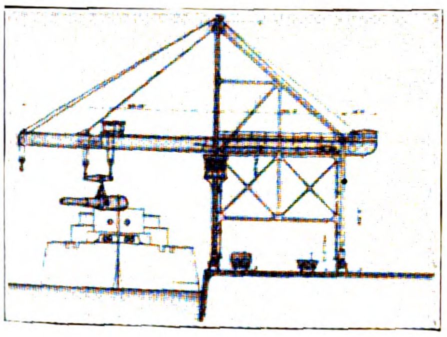
Fig. 5.—75 Ton American Crane.

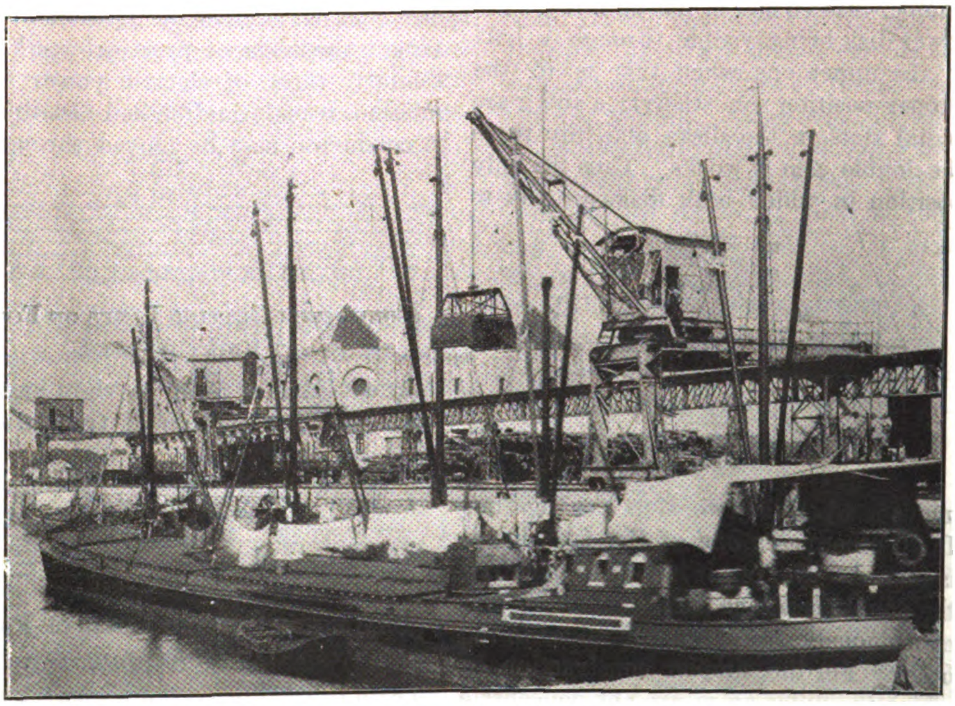
Fig 6.—German Electric Half-Portal Crane.

A MULTIPLE-DIAL POTENTIOMETER.*

BY ALBERT CAMPBELL, B.A.

Some two years ago, in planning a low resistance potentiometer which I was building for myself, I was led to consider what would be the best construction, from the point of view, first, of ease of mechanical construction, and secondly, of accuracy, convenience of reading, and compactness. There seems no doubt that circular motion is easier to attain mechanically than rectilinear, and besides, a couple is applied with more ease than a single force, or, in ordinary language, a turning head is handier than a slider guided in a straight path. The latter requires much more movement of the hand and a steadier support for the instrument. Thus I decided on a thick slide wire, which could be bent into an arc of a circle, and a number of studs for the other contacts, the arrangement being as in Fig. 1, where A is a fixed resistance, on which to balance a cadmium cell, and V is the voltage to be measured, the whole a tolerably familiar construction. I wished, however, to have both convenience and accuracy, and accordingly decided to have 100 coils in the resistance at B. To have arranged these 100 coils all in one circle meant considerable mechanical skill and a great area of ebonite, but I found that both of these difficulties were got over by the device I proceed to describe; although very simple, I believe it is quite novel. Instead of arranging the 101 studs in one circle, I placed them in two sets as shown in Fig. 2 at C and D, but the last stud F on dial C was connected, as shown, to the turning head of dial D. Thus, when the slider of C has exhausted all its 50 coils, it arrives at F, and so switches the second slider into action on dial D. The switch-over stud F is marked blank, the other studs being numbered consecutively. Clearly the same principle can be applied to any number of dials, the only disadvantage of the method in its simplest form being that one must be careful always to read on the first dial that does not show a blank. This trouble may be avoided in various ways. When the sliders are fitted with number-disks, showing one figure at a time, it is not difficult to arrange that the reading of the second dial

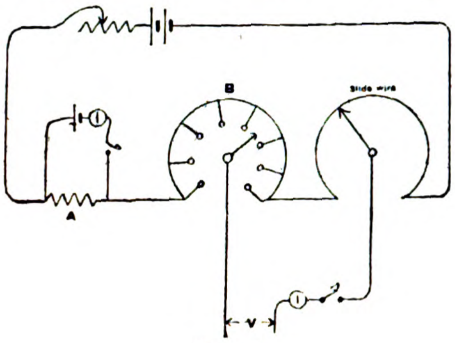

FIG. 1.

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*From the "Electrical Review," London.

shall be kept hidden by the rim of the first disk, except when the first slider is on the switch-over stud F. In the actual instrument that I built, I got rid of all uncertainty by adding an interlocking arrangement, so that the second slider remains locked at its zero position until the first slider is turned to stud F; then, on turning the second slider onwards, the first is locked on stud F and cannot be moved until the second is brought back to its zero position again. The simple mechanism by which this is accomplished is shown in Fig. 3 (omitting irrelevant mechanical details). The two dials are fixed one over the other, and the sliders, S_1 S, are carried by concentric hollow spindles, whose heads N and P come close together in the hand. The spindles carry number-disks Q and R, the figures on the lower disk being visible through a hole in the upper one when this is in the proper position (on stud F); e and g are radial slots in the disks, and into these the double cam K works. Thus the only position in which both disks are free to move is when the two slots are together In all other cases one of the two sliders is locked. The result is that in handling the double head one passes smoothly and continuously from the one slider to the other. For the simpler construction, in which the slider axles are not concentric it is easy to modify the cam mechanism to suit. In conclusion, I may remark that the above device of multiple sliders can similarly be applied to a long slide wire subdivided into a number of sections.

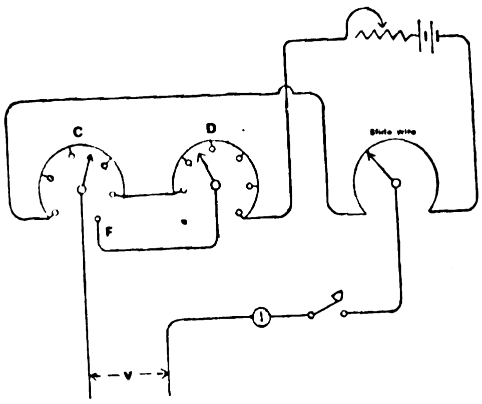


FIG. 2.

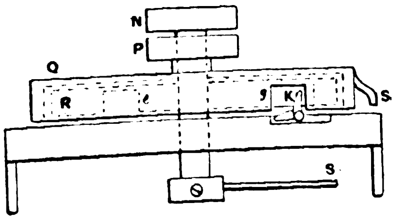


FIG. 3.

The ore mills of Joplin, Mo., will be operated henceforth by electricity.

ELECTRICITY LEAFLETS.

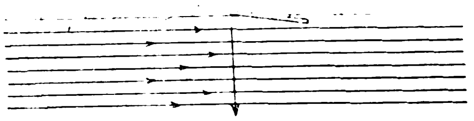
BY NEWTON HARRISON, E. E.

THE DYNAMO.

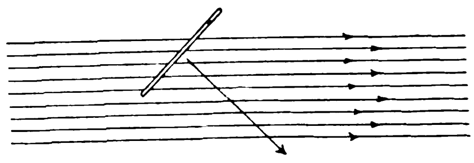
The Generation of Electromotive Force.—A dynamo is essentially a machine which generates electromotive force. The process of generating electromotive force, or EMF. as it is called for abbreviation, is by means of conductors moving in a magnetic field.

When mechanical energy is applied to conductors which are passed through magnetic lines of force in a certain direction, an EMF. is developed in them, which will be proportional to the speed with which they are moved, the number of conductors moved, and the strength of the magnetic field. The current produced in these turns or lengths of wire will be proportional to the EMF. generated and inversely proportional to the resistance. A dynamo, therefore, is a machine in which mechanical energy is transformed into electrical energy. A motor in contradistinction is a machine in which electrical energy is transformed into mechanical energy.

Both the motor and dynamo are mutually convertible into each other by the mere fact of applying either power in a mechanical or an electrical form. This identity of these two machines or types of machines has been of the greatest importance in the fields of practical work, particularly those of electric power transmission, transformation and distribution. A conductor may be moved through, or may cut lines of force at right angles to itself or by a motion of translation, as shown in the illustrations. If the field is the same in one case as the other, it is evident, that in covering a given distance the conductor will cut more lines of force in the first instance than in the second. It is only to be expected in such a case that the conductor cutting the greatest number of lines of force in a given period of time is the conductor generating the greatest EMF.



CONDUCTOR CUTTING LINES OF FORCE AT RIGHT ANGLES.

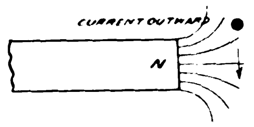


CONDUCTOR CUTTING LINES OF FORCE AT AN ANGLE.

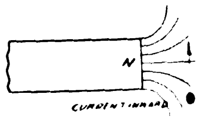
But there is another fact to consider, of the utmost importance in connection with this subject, and that is the character of the magnetic field in which a conductor or conductors are moved to produce EMF. If the magnetic field is uniform and the conductor when moved at a uniform rate of speed cuts through just as many lines of force per second in advancing as it has left behind, then no EMF. can be produced.

Variation in Field or Motion.—The physical law upon which the generation of electromotive force is based requires the absence of uniformity in the motion of the conductor through a uniform field of magnetism. The conductor must move in such a manner that the number of lines of force it cuts are constantly changing in number. In other words, it may be stated that the generation of EMF. depends upon a variation in the number of lines of force intercepting the conductor.

Motion of Conductor Downward.—The direction of motion plays a great part in the direction of the current in a conductor exposed to the influence of lines of force. The conductor when so affected develops positive and negative electricity at ends which reverse their polarity when the direction of the motion is reversed. For instance, if a conductor is moved downward in front of the north pole of a magnet the current will tend to flow outward from the paper. This motion of the conductor in a field, in which the movement causes a variation in the number of lines of force around it, is productive of E.M.F. The exact nature of the reaction which takes place, through which a closed electric circuit, when so moved in a magnetic field, is able to absorb mechanical energy and give out its equivalent in electricity, even if known, would have no influence upon the practical application of this principle in electro-magnetic machinery. Such knowledge would merely add another link to the chain which is being slowly forged in the physical laboratories of the world; connecting fact with fact and associating principle with principle for the purpose of showing the truth of great generalizations already made.



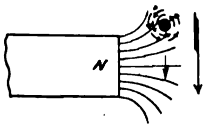
Downward Motion Current Outward.



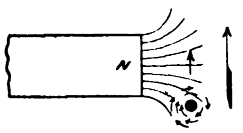
Upward Motion Current Inward.

Motion of Conductor Upward.—When a conductor is moved upward in front of the north pole of a magnet EMF. is generated. In this case the positive and negative poles of the conductor will be at such ends of the wire that the current with reference to the paper will tend to flow inward. Thus it is evident that an up and down motion to the conductor in front of the north pole would produce a series of electromotive forces which would be proportional to the number of movements per second, the strength of the magnetic field, and the length of the conductor in operation. There is this physical fact to note, in reference to such an experiment: that the reaction between the power applied and the magnetic field is very similar to the reaction between a sledge hammer blow and an anvil. The reaction throws the hammer off as mechanical energy, whereas the reaction between the conductor and the magnetic field, though not visible, still occurs in the form of an EMF. and current, which produces as startling a reaction if the proper means are taken to observe it as the hammer and anvil.

Direction of Field Around Inductive Wires.—A wire producing EMF. is acting as an inductor because an EMF. is being induced in it. The blow of a downward moving wire, upon the lines of force of a north pole produces a magnetic whirl around the wire, coincident with the generation of its EMF. and its polarity, or positive and negative ends. A reversal of the motion produces a reversal of the magnetic whirl around the wire, and of its electrical polarity and EMF.



Direction of Whirl Around a Downward Moving Wire.



Direction of Whirl Around Upward Moving Wire.

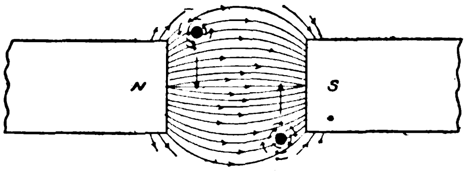
Motion, therefore, in a given field plays an important part in giving direction to the current as well as in governing the amount of EMF. developed. By this is meant that an up and down motion of a conductor in a field as shown would produce a current which would be constantly reversing; while, on the other hand, the rapidity with which the motion occurs would control the EMF.

If this experiment could be regarded as that of a stout metal rod striking a lot of projecting flexible steel wires it is easy to see that a downward and upward blow would make them coil around the rod in opposite directions respectively. There is this difference, however, that in the case of the metal rod, energy is consumed with each motion, while in the case of a moving conductor energy is consumed only in proportion to the current which flows. Consequently, if the conductor does not form part of a closed circuit only EMF. and no current results, and no energy is consumed. This fact is of importance because it shows that a dynamo on open circuit, although producing EMF., only takes from the engine enough power to overcome the requirements of friction at the bearings, commutator, etc.

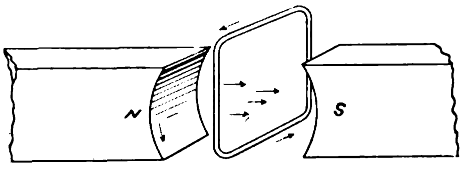
The direction of the magnetic whirl around wires moving in a magnetic field is an indication of the direction of the current in them. The presence of this magnetic whirl, however, acts as a deterrent to the motion of the wire. It is this which constitutes in a mechanical sense the reaction. In fact, it is impossible to produce a current in a wire by its movement through a magnetic field without experiencing this drag on the conductor.

Elements of a Dynamo.—If a north and south pole are now placed opposite to each other, the magnetic lines have a free path across to the south pole.

The direction of the lines of force from the north pole have not changed because of the presence of the south pole, in fact, they continue on their way unchanged into the south pole. A conductor moving downward in front of the north pole produces a magnetic whirl which is in the opposite direction to the whirl produced around the conductor moving upward in front of the south pole. This means that the current issuing from the first wire will flow in an opposite direction to that issuing from the second wire. If they were connected at their ends and then rotated around an axis instead of being individually moved up and down in the magnetic field, practically the same movement would be accomplished by circular motion.



Elements of a Dynamo.



Motion by Rotation.

In a dynamo this practice is followed out, and the result is that the conductors constantly produce a reversing or alternating current. Certain practical details require attention in this respect in order to outline the conditions resulting from such an arrangement in actual practice.

Alternating and Direct Currents.—First, it may be stated that there are two kinds of dynamos in use for electric lighting and electric power. They are called alternating and continuous or direct current machines. The difference between one class of machines and the other is entirely due to the fact that in the first class, the alternating current, the electrical energy is permitted to issue in the same manner as it is produced or generated. In the other class, the direct current, the alternations or reversals of current are rectified by means of a device called a commutator. This device is the means of causing all the impulses of current to be divided up into those which leave at the positive and those which enter at the negative pole. In other words, it sends out all positive currents from one pole of a dynamo and all negative currents from the other. The difference, therefore, between so-called alternating and direct current machines is not due to the fact that they generate different currents, because both develop alternating currents, but is due to the fact that the direct current machines have a commutator or rectifier and the alternating current machines have not.

The Calculation of EMF.—The meaning of the word current with respect to electricity has no significance unless associated with EMF.

The development of EMF. takes place under certain conditions in the case of a dynamo. There are three elements necessary, consisting of lines of force, conductors and motion. Cases arise in connection with alternating and direct currents where motion is not apparent. Yet it is there; if not visible, it must be the motion of the magnetic field. If a conductor is held stationary, and a magnet moved so that its lines of force cut the conductor, a parallel case is presented. But even in this instance the magnet is moved, whereas in those referred to the particular conditions allow only the magnetic field itself to move.

Value of One Volt.—The evolution of a volt in terms embracing the above conditions is carried out on the following basis: One volt is equal to the cutting of one hundred million lines of force by one conductor in one second. The conclusions to be drawn from this statement are obvious. If one hundred million lines of force must be cut by one conductor to generate one volt, then one-half as many cut by two conductors in one second or one-quarter as many cut by four conductors in one second will generate one volt, etc. From this statement is drawn the material for a very simple formula, by means of which the EMF. of a dynamo is calculated before construction takes place as follows:

EMF. in volts = number of lines of force × number of conductors × revolutions of the wire per second ÷ one hundred millions. Transcribing this formula into symbols for convenience:

$$E = \frac{L.\,F. \times S \times r}{100,000,000}$$

Where L. F. = lines of force.
S = conductors.
r = revolutions per second.
E = EMF. in volts.

To illustrate the application of this formula let L. F. = 5,000,000, S = 100 and r = 20, which represents 1,200 revolutions per minute. The volts would equal 5,000,000 × 100 × 20 divided by 100,000,000 which equals 100 volts.

ON BATTERIES WITH REVERSIBLE BOOSTERS.*

BY C. TURNBULL.

(Concluded from page 25.)

Size of Cells.—Given a booster with the above properties it is not difficult to arrive at the size of the cells. Thus, with an output of about 3,000 units per day of 16 hours we can do it with a generator which will do 200 kw. as ordinary full load, with, say, a 25 per cent. overload capacity to meet excessive and occasional rushes. As we can now get economical triple-expansion engines or turbines which will run economically for long hours at full load and that will give off overloads either by means of valve gear or by working as compound engines, this part of the problem is easily solved. We must then put in a battery which will be large enough to meet the maximum load of the station when running in combination with the generator. Where the hours of actual load are longer or shorter than the 16 hours mentioned above, or where there is little or no load during part of them, then the problem can be solved in a similar manner. Given, however, a booster which will work in harmony with its generator as above, the solution will not be difficult, and a good deal can be done by varying the hours of running of the generator to suit. In buying cells under maintenance, it should be arranged that the circuit breaker should be set as high as possible. This is really unobjectionable, seeing that heavy discharges are only momentary, and, further, the battery usually is not run down at all in working.

Type of Cells.—The actual work done by the cells when working with a reversible booster is very little. For although the curve of charge and discharge looks large enough in importance when it is examined on the recording ammeter chart, still the peaks integrate to very little. We, therefore, want a cell which will do with very heavy discharges, and also with considerable charges, but that does not necessarily have a large long hour capacity. Durability is more important than efficiency. As a matter of fact it is well known that a cell which receives charges and discharges at short intervals has an extraordinarily high efficiency, and a slight reduction in this if it gave increased durability would not matter. I have been informed by one of our leading accumulator firms that a cell to meet those requirements can be made and maintained at about half the ordinary price if it be asked for, and I hope that such will be on the market in the near future.

Space for Additions.—It is a great advantage to have the cell boxes large enough to allow of the addition of more plates. This enables the size of the battery to be kept down, as it is easy to increase its capacity. If, however, more plates are added, then it is not desirable to simply put the new plates in parallel with the old ones. Old plates should be taken from some of the cells to make up the additional number required in the other cells, and the cells thus depleted should be made up entirely with new plates. The space at the side is useful in assisting the much-desired circulation of the acid. It also enables the cells to be inspected by an inspection lamp on an L-shaped stick. This lamp put under the plates shines upwards and shows any shorts clearly.

Space at Bottom.—The space at the bottom of the cells should be ample, about 6 inches or so, so as to obviate frequent cleaning.

Number of Cells.—The possible variation of cell voltage is from 1.8 to 2.7 volts per cell, the last figure being obtained with the fortnightly overcharge, which makers recommend to be given to the cells. In ordinary working the variation is from 1.9 to 2.5 volts. Provided that the booster is arranged to prevent the current from coming back on to the generator, the number of cells may be varied considerably. I think, however, that 250 cells is a suitable number where the 'bus-bar pressure is between 500 and 550 volts. If fewer cells be used, a good deal of work is thrown upon the booster to pump the current out of them, and if more cells are installed there is a danger of the current coming back on to the generator if they be floated on the line without the booster when fully charged.

Instructions for Running the Battery.—This is a matter of great importance, and, unfortunately, battery makers usually give little resistance. It will be seen that it is necessary in working to insure that the battery has just the right proportion of current to put into it. Meters are of some assistance towards this end, but they must not be relied upon too much. It is doubtful if meters are quite accurate on the violently changing loads of a traction battery. Furthermore, it is likely that the effect of a discharge on the battery varies with the rate and also with the state of discharge that the battery is in. One hundred ampere hours taken out of a battery just freshly charged will not need the same extra percentage to be put back that the same amount would need from a battery well run out—at least, I think not; indeed, so long as the load is of such a kind that the battery gets a charge immediately after a discharge—as happens when working with a reversible booster—then the excess percentage of charge over discharge in ampere hours need be very little.

The advice is sometimes given that the booster should be worked so that the battery is charged every night at shutting-down time. This is impracticable without an undue amount of attention. The most practicable way that I have found is as follows: During the morning when the generator is started up, there is usually a slack time, so that it can be arranged that the battery is mainly charging. The battery attendant should be in the battery-room now, and he should go round and see that every cell gases up at the same time. He should watch the battery when it is gasing, and, at the same time, top up any cells with water if necessary. The water can be put in by a long glass tube, about 1½ inches in diameter, with a bell mouth. This will enable the water to be put in at the bottom, and it can be stirred about and well mixed with the acid. The amount of gasing and volts per cell necessary on the daily charge should be determined by the battery makers, whose assistance should be freely requisitioned at first start up. When the cells are full up, the attendant should inform the engine-room staff, so that the booster can be regulated, so that the battery can be discharged for a time rather than charged. When a little current has been run off, the adjustment can be made so that charge and discharge are about equal or as needed. This method of working the battery needs a minimum of attention and will be found very satisfactory in practice. Once a fortnight—if required by the makers—an extra charge can be put in, which will bring the voltage up to 2.6 or 2.7 per cell. This should be done at a quiet time, when the charge can be put in fairly steadily. The volts of each cell can then be taken on the top of the charge. The gravities of the cells can also be taken at the same time. The gravities can be relied upon to some extent to tell if the cells are getting their proper charge, but still these are affected by the addition of water to make up for evaporation. If a maintenance scheme is entered into, it should be on condition that the battery is to be worked on lines like this, and not on lighting battery lines.

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*Paper read at the meeting of the Newcastle Section of the British Institution of Electrical Engineers, December 12, 1904.

Maintenance.—The question of the maintenance of batteries by makers is a thorny one. If the makers are good, substantial and decent people, then there is some assurance to the owner of the battery in having a maintenance. Otherwise, it may happen that after several years of maintenance have been paid that when repairs are needed the makers get out of their agreement by one of those curious clauses with which they fill their agreements. I mean, for instance, such a clause as that which states that the payments are to be made to the company without demand. It is possible to reduce the amount of the maintenance payment by stipulating for the battery to be kept up to, say, 90 per cent. of its original capacity instead of to the full capacity, and this is usually quite enough for reversible booster work. Indeed, with this proviso, the upkeep rate for a battery should be extremely low. The maintenance agreement should be settled as to terms before the order for the cells is definitely placed, as this will enable a better bargain to be struck. The user of the cells should then stipulate for six months' use of the cells before deciding whether to enter into the maintenance scheme or not. It is also desirable that the agreement should last over a long term of years—say 10—but with the user's option of terminating, say, after five years.

Water.—The question of water should be settled before the contract is placed. The makers usually stipulate for pure water only to be added to the cells, but if the town water is good this is allowed. If this is not good, then the user is in a quandary as to how to make up the evaporation. Condensed water from a boiler is not always suitable, as it may contain boiler compounds, if such be used, or iron. Makers do not always help in the matter. Thus I know of one case where the engineer asked them to provide a distiller to provide make-up water, and they offered one, after several weeks of correspondence, for about £400. Rain-water is often too impure. I think that a simple distiller could, however, be made by using a gas jet under a boiler. The steam would go through a worm, and would be cooled by water in a tank. After the worm had gone through this tank it would go through a second tank. The boiler and the two tanks would be connected by a pipe so that the water would stand in the same level in all. This would cause the boiler to be automatically fed with hot water. A tap could run into the last tank to keep up the level, and also to provide cooling water.

Battery-Room.—It is often stated that battery-rooms should be well lighted. Actually too much light in a battery-room is bad, as it renders cell inspection difficult. The room should be rather dark, with good artificial lighting. The wiring may be done on insulators. At intervals lamps should be provided on long flexes of Lyric 3 25 R.C. wire for looking into the cells from above. Hooks should be provided to hang these lamps on when not in use. I have found acid-resisting paint liable to chip off a concrete ceiling, but wood varnished with acid-resisting varnish has stood better. The ventilation should be good, but of a nature to prevent flies and dust from coming in too freely.

Milking Booster.—This should be run off the lighting circuit so as not to be shut off if the main circuit breaker of the traction generator is blown. It is a debatable point as to how the leads should be run for milking up the cells. In the diagram, I show them run under the grating on the floor, being supported on insulators. The flexible leads can be connected by means of screwed plug handles. A small switchboard can be fixed in one end of the room, or possibly in a small room provided for the purpose. Where the cells are on two floors the switchboard should be provided with one pair of switch fuses only, to connect either the upstairs leads or the downstairs leads on to the 'bus bars. The use of a single pair of switch fuses prevents any attempt to milk up two parts of the battery at once, as, of course, only one pair of flexible leads is kept in a room. The booster can be put in a convenient place, but the regulation of its volts can be done from the battery-room. The booster may also be arranged to provide heavy currents for meter testing purposes. The board should have a polarized ammeter and a voltmeter with paralleling and other stops on the switchboard.

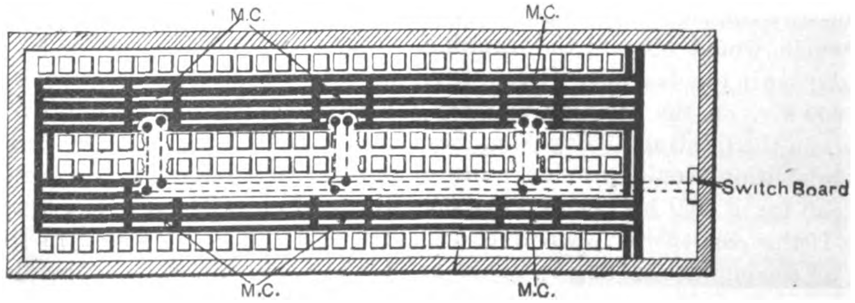

Diagram showing Arrangement of Trolley Wire Conductors for Milking-up Cells. The Grating is shown Broken Away to show the Trolley Wire which is underneath. M. C. indicates Movable Coves by which Plugs are got at.

Grating.—The grating for the battery-room floor can be made of rough wood dipped into melted pitch. This makes quite a cheap and satisfactory arrangement.

Reversible Booster Switchboard.—The breakers, of the booster motor and battery, should be on the live side, but most of the rest of the instruments on the board may be on the earth side. The motor breaker should be arranged to shut off the battery current, if it comes out so that the booster may not race owing to the battery current running through it. On the other hand, it is desirable to have the breakers arranged so that the blowing of the battery breaker does not stop the motor.

Meters.—Wattmeters may be used with the shunts taken off the 'bus bar, so that they virtually become ampere-hour meters. I have tried oscillating meters, which have the advantage that they do not need any pawls to stop them from running reversely. I think that mercury electrolytics or some shunted ampere-hour meters with a small drop might be used. One shunt would do for both. In this case the auto switch for putting either one or the other in circuit, according as the battery was charging or discharging, would be simply a mid-zero ammeter type of instrument, only that the pointer would have a contact on the end. This contact would swing up against one or the other of fixed contacts, and so direct the current into the right meter.

Testing of Meters.—It is not essential that the integrating meters should be absolutely correct, but it is essential that they should agree with each other, or that their differences should be known. They can easily be tested for this by simply reversing the connections of one so that they both read for charge, or discharge, for a day or two. The readings thus got will show whether the meters are agreeing.

Shunts.—The abomination of several shunts in series—one for the ammeter, one for the recorder, and one for the integrators—should be avoided. One shunt should do for the lot, or if two in series be used, then the instrument having the heaviest drop should come off the combined resistance of the two shunts. In this latter case the two shunts in series should be soldered together, so that the combined resistance could not be affected by bad contact.

Arrangement of Plant.—In some stations I think it would be a good thing to couple the booster right on to the main generator shaft, so as to save motor losses. In many cases I think it would be well to run traction and lighting dynamos in tandem on the same engine.

Where a reversible booster was in use, the load on the traction generator would be steady enough to prevent flickering on the lighting boards due to variations in the engine speed. Two ideas are possible—either the generator can be looked on as a traction generator, in which case the traction dynamo would be equal in capacity to the engine, and the lighting dynamo would be equal to the day load on the lighting board; or the lighting dynamo can be of the engine capacity and the traction one smaller. At night or on the peak loads, of course, when desired the loads could be separated out. The lighting dynamo could have the mid-wire connection through choking coils, which would obviate the running of a balancer in the daytime. Given, say, some 200 kw. on the traction and, say, 100 kw. on the lighting all day long, then the combination would provide quite a good load for a 400 kw. or 500 kw. engine. If the condensing plant were run direct off the engine shafting by chain or other gearing, we would have a very economical omnibus plant for many stations. Of course, one may say there would be a lot of eggs in one basket in case of breakdown, but then plant does not break down now as it used to, and, of course, the ordinary stand-by plant would be necessary as it is now. The amount of current that runs to waste nowadays in running balancers and motors for various purposes is so enormous that it is worth while to do something to save it.

Conclusion.—I have written this paper at somewhat short notice, although, of course the subject has been in my mind for a long time. Had I had more time it would have been possible to provide more diagrams, but I hope that the absence of them will not be unduly felt. Indeed, the style of the diagrams necessary to illustrate a paper of this kind is so well known that it is doubtful if they are necessary. I can only hope that the contents of the paper will be useful and interesting to all concerned in matters of this kind.

AN INTERPLANETARY TELEPHONE.

(Editorial in New York Times, Jan. 15.)

The actual achievements of electricians in the modern period have been so marvelous, so outrunning the wildest dreams which the imagination could have pictured for them, that, no matter what those magicians say they can do, the world, not allowing itself to be affronted with any reach of extravagance, is bound to stand still and listen. Mr. Nikola Tesla has such a score of electrical achievements to his credit that when he tells us he is going to wake up Mars one of these days, and possibly some other planets, with an oscillator of ten million horse power which he is getting up, we are obliged to take the statement into more or less serious consideration.

The instrument, according to his declaration, presents no unusual difficulty. He says he can make one representing a much higher power, say that of a thousand million horses, and with this some foundation is given for the belief that he can do with the world and the whole planetary system pretty much what he likes. Such a scheme fatigues the lay imagination, exhausted with previous surprises of all kinds which the inventing electricians have prepared for it, and it is not easy to say in the first shock of wonder attending the declaration what the world and its societies, near and far, all very much interested in the matter, ought to do about it. Confiding such a large force to the will and discretion of an individual, or even of a consolidated stock organization, looks rather perilous. It seems as if the stability not only of the cloud-capped towers, the gorgeous palaces, and the solemn temples, but of the great globe itself, with even some of its outlying siderial sisterhood, would in such case stand in much peril.

Such a force as Mr. Tesla names outruns the widest reach of mundane conceptions. The idea presents to the mind a sublime image of disturbing forces in action; shows how their potencies lie bosomed in the stillness and calm of the universe; but there is nothing attractive about it, and it promises no usefulness of any kind. The fancy of conversing with supposititious inhabitants of our next-door planetary neighbor has taken strong hold on the minds of electricians, astronomers and others in recent times, but when we come to think about it, what possible good could flow from opening communications with that lurid star, shedding its trails of fire and dews of blood, and carrying around in its revolutions a population which we might not like to have anything to do with? The best wish that can be made for Mr. Tesla's intentions and inventions in that direction, is that they will not come to any substantial result, as they probably will not. Mars will no doubt go on in its old courses, not heeding any of our signals, and in no increased degree "subject to the Constitution of the United States," whether Mr. Tesla turns his batteries on it or not.

Of more mundane possibility seems his invention of a torpedo which will go by itself any distance with unerring aim and blow the biggest warship into smithereens in a jiffy. This he thinks is destined to put a stop to the building of such vessels everywhere, and also render useless everything in the nature of fortifications existing in the world. If his invention had only been a little further advanced it might have helped the Japs to capture Fort Arthur in a forenoon, instead of being the better part of a year about it.

With predictions of so much confidence and grandiosity from those who have really wrought miracles in their electrical craft to make the exploits of Simon Magus and the Sorceress who contended with Aaron seem the cheap wonders of a side show, the only thing the public can do is to sit still and wait, disciplined in the experience that the highest expectations sometimes blow over, as on the whole it is well they should.

The National Automobile Exhibition.

Last Saturday night the fifth annual National Automobile Exhibition was opened at Madison Square Garden in this city, and thousands of spectators and admirers of the auto were present.

Two hundred and fifty exhibitors are represented in the show. Fully fifty more applied for space and had to be refused owing to lack of accommodations. Those who did succeed in getting space had to be content, in every case, with one-third of the display-room asked for.

There are 100 exhibitors of machines

of all sizes and kinds, from the runabout to the touring car. Each of these shows on an average three autos, making a total of 300 machines on exhibition. They range in price from $650 to $6,200.

The electrical effects this year are in keeping with the other improvements, and are better and brighter than at any previous show.

The exhibition will continue throughout the week, winding up with the annual banquet of the Automobile Club of America on Saturday night.

Electric Vehicle Company Wins Important Suit.

Suit against the Panhard & Levassor Company, prominent French automobile manufacturers, has been pending under the basic Selden United States patent for the past year. This suit has been decided against the Panhard Company. Hereafter all automobiles imported by the company will be under license from the Electric Vehicle Company.

Simultaneously is announced that all Mercedes, the celebrated foreign make of automobiles, will be imported under license from the Electric Vehicle Company. There are now 31 American manufacturers licensed by the Electric Vehicle Company under the Selden patent, and nine licensed importers.

Pittsburg to Have $50,000,000 Subway.

It is announced that H. C. Frick has completed plans for a system of subways to the suburbs of Pittsburg, including tunnels under both rivers to Allegheny and the South Side. The plan also includes the erection of a new skyscraper and a terminal for the Pennsylvania Railroad. It is said that Postal Telegraph interests are also involved, and that the company will remove its headquarters from New York.

Wants a Receiver.

Merle J. Wightman, of New York, has filed a bill in Chancery, at Trenton, N.J., asking that a receiver be appointed for the Pyro Electric Company, of which he is vice-president and the owner of 1,118 shares of stock. The company has a paid-in capital of $500,000, which, according to the bill, has been expended in procuring patents and manufacturing machinery for the production of heat by electricity. The company has assets of $4,127, and liabilities of $10,908.

Massachusetts Street Railways.

The street railways of Massachusetts had, as shown by the annual report of the railroad commissioners, a very disastrous year in 1904. The report shows a deficit after the payment of all charges and dividends amounting to $216,383, as compared with a surplus of $16,668 in 1903 and $250,140 in 1902. The deficit is said to be primarily due to over-promotion.

The Schwerdtle Stamp Company.

The engraving and steel stamp business of the Schwerdtle Stamp Company, 39 Fairfield avenue, Bridgeport, Conn., and the rubber stamp business of the Bridgeport Stamp Company, 156 Fairfield avenue, have been incorporated under the laws of the State of Connecticut, and will hereafter be known as the Schwerdtle Stamp Company. The new company receives all the assets and assumes all the contracts and obligations of both old firms, and has opened for business in its new building, 39 and 41 Cannon street. The new factory has been equipped with increased facilities, including modern machinery, new type, etc., and will be able to handle increasing business more promptly and satisfactorily than ever before.

Prof. W. S. Barstow will deliver a lecture on the "Electrical Plant," at the Brooklyn Polytechnic January 23.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JAN. 10, 1905

Electric Railways and Appliances.

779,441. Trolley Device. Henry O. Reese and Henry C. Weitzel, Baltimore, Md. Filed June 10, 1904.

779,448. Life-Guard for Electric Tram-Cars or Other Road Vehicles. William A. Turner, Marple and George A. W. Turner, Stockport, Eng. Filed Oct. 7, 1904.

779,475. System of Electrical Distribution for Electric Railways. Josef H. Hallberg, Cincinnati, O. Filed Feb. 26, 1904.

779,554. Trolley-Bridge. Robert T. McCarroll, Columbus, O., assignor to the Columbus Steel Rolling Shutter Company. Filed June 4, 1904.

779,654. Trolley-Retriever. Emil J. Jonas, Hamlet, O., assignor of one-fourth to Philip M. Offutt same place. Filed April 1, 1904.

779,739. Protective Device for Third Rails. John Ryan and Anthony C. Guntzer, New York City. Filed Nov. 5, 1903.

779,850. Trolley for Electric Railways. George C. Hobein, Norfolk, Va. Filed Sept. 17, 1904.

779,895. Signaling Circuit for Railways. Adoniram J. Wilson, Westfield, N. J., assignor to the Hall Signal Company, New York City.. Filed Feb. 10, 1902.

779,920. Track-Switch for Electric Railways. George H. Fretts, Springfield, Mass. Filed March 25, 1903.

Electric Lights and Appliances.

779,539. Electric-Arc Lamp. Walter C. Fish, Lynn, Mass., assignor to the General Electric Company. Filed June 24, 1901.

779.779. Electric-Lamp Fixture. Edwin E. Hayward, Waterbury, Conn., assignor to the Plume & Atwood Manufacturing Company, same place. Filed June 8, 1904.

779.948. Electric-Arc Lamp. Heinrich Lux, Schoneberg, Germany, assignor to the Allgemeine Belauchtungs und Heiz Industrie Actien Gesellschaft, Berlin, Germany. Filed June 8, 1904.

Electrical Machinery and Apparatus.

779,427. Electromagnetic Metal-Working Machine. Francis W. Jessop, Cleveland, O. Filed March 30, 1904.

779,447. Electric Controller. August Sundh, Yonkers, N. Y., assignor to the Sundh Electric Company. Filed June 3, 1904.

779,469. Coupling for Electric Cables. John J. Dossert, New York City, assignor, by direct and mesne assignments, to Dossert & Co. Filed July 16, 1903.

779,532. Connection-Board for Dynamo-Electric Machines. John G. Crawford, Lagrange, Ill., assignor to the Western Electric Company. Filed May 13, 1904.

779,575. Polyphase Winding. Bernard A. Behrend, Norwood, O., assignor to the Bullock Electric Manufacturing Company. Filed Nov. 6, 1903.

779,685. Current-Meter. Warren S. Blauvelt, Grosse Ile, Mich. Filed March 9, 1904.

779,720. Voltage-Regulator. Orra M. Lacey, Hanford, Cal. Filed Nov. 9, 1903.

779,737. Shunt for Electrical Measuring Instruments. Lewis T. Robinson, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 18, 1904.

779,822. Bearing for Electric Meters. Frederick M. Vogel, Lynn, Mass., assignor to the General Electric Company. Filed July 13, 1903.

779,828. Insulator-Pin. Montraville M. Wood, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 8, 1903.

779,875. Automatic Motor-Starting Rheostat. Ernest Schattner and Caryl D. Haskins, Schenectady, N. Y., assignors to the General Electric Company. Filed May 13, 1904.

779,889. Reversible-Current Apparatus for Condensers. John Todd, Seattle, Wash., assignor of one-half to George Winfield Wilson, same place. Filed March 14, 1904.

Telephones and Telephone Apparatus.

779,443. Telegraph and Telephone Transmission Line. Eugene F. Roeber, Philadelphia, Pa. Filed March 9 1901.

779,497. Apparatus for Telephone Trunk-Lines. Walter O. Pennell, Philadelphia, Pa., assignor to the Western Electric Company. Filed Nov. 23, 1900.

779,504. Telephone-Bracket. Samuel J. Seifried, Chicago, Ill., assignor to the Chicago Writing Machine Company. Filed Sept. 25, 1903.

779,533. Party-Line Telephone System. Willam W. Dean, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed June 15, 1903.

779,811. Selective Party-Line Telephone System. Albert J. Springborn, Cleveland, O. Filed April 3, 1903

779,893. Selective Signaling System. William D. Watkins, San Jose, Cal., assignor to the Watkins Manufacturing Company, same place. Filed Nov. 4, 1903.

779,940. Support for Telephone-Receivers. Frank F. Howe, Marietta, O. Filed Sept. 23, 1904.

779 982. Selective Telephone System. Peter J. Albrecht, Marion, S. D. Filed July 25, 1904.

Miscellaneous.

779,432. Polyphase Magnet. David L. Lindquist, Yonkers, N. Y., assignor to the Sundh Electric Company. Filed May 23, 1904.

779.508. Art of Electrical Wave Transmission. Daniel M. Therrell, Atlanta, Ga. Filed Feb. 17, 1902.

779,524. Printing-Telegraph System. John Burry, Ridgefield Park, N. J. Filed April 9, 1904.

779,553. Protective Covering for Storage Battery Plates. Achille Meygret, Paris, France. Filed April 6, 1904.

779,589. Electric Battery. Frederic P. Dewey, Washington, D. C. Filed March 25, 1902. Renewed May 19, 1904.

779,592. Signal System for Elevators. Bartholomew J. Foley, Pittsburg, Pa. Filed March 12, 1900.

779,623. Electric Pump. Edwin F. Porter, Boston, Mass., assignor, by mesne assignments, to the Porter Air Compressor Company. Filed Feb. 9, 1903.

779,670. Telegraph System. Harry Shoemaker, Philadelphia, Pa., assignor of one-half to Marie V. Gehring, same place. Filed Oct. 11, 1902.

779,673. High-Frequency Induction Apparatus. Chas. L. Spaulding and Robert E. Austin, Kansas City, Mo., assignors of one-third to William R. Clarke, same place. Filed April 25, 1904.

779.693. Battery-Zinc. Frank J. Delavie, Pittsburg, Pa. Filed July 1, 1904.

779,733. Electrode. Edgar F. Price, Niagara Falls, N. Y., assignor to the Union Carbide Company. Filed June 28, 1904.

779,735. Electrolysis. Giovanni Rambaldini, Minfera di Boccheggiano, Italy. Filed Jan. 28, 1902.

779,810. Electric Branding Apparatus. David C. Sprecher, Kansas City, Kan., assignor of one-half to John E. Doran, Kansas City, Mo. Filed Nov. 15, 1904.

779,844. Electric Furnace. David R. S. Galbraith, Auckland, New Zealand, assignor of one-half to William Steuart, same place. Filed Oct. 27, 1903.

779,996. Inductance-Coil. Walter C. Fish, Lynn, Mass. Original application filed June 24, 1901. Divided and this application filed Sept. 3, 1903.

THE TELEPHONE WORLD.

Independent Securities Company Obtains Many Lines.

An important deal has lately been consummated whereby the Independent Telephone Securities Company of Utica, N Y., secures control of the property of the Black River Telephone Company, whose lines extend from Utica north along the line of the Rome, Watertown & Ogdensburg Railroad to Sacket Harbor and Watertown, and from there through to Adams and Pulaski, and at the latter point working in conjunction with the Ontario Telephone Company of Oswego, whose lines also extend to Syracuse.

The Black River Telephone Company has exchanges in 22 villages, and operates over 1,000 telephones; has over 500 miles of toll lines in the northern part of Oneida, Lewis, Jefferson and Oswego Counties, nearly all of the lines being full metallic circuits and fully half of them of copper.

It is understood that both the Independent and Bell interests have for some time past been negotiating for the Black River line.

The Independent telephone exchanges in Cooperstown and Richfield Springs, together with the rural lines of the Otsego Home Telephone Company in and about Cooperstown, have passed into the hands of the Independent Securities Company of Buffalo, a branch of the syndicate now controlling the local companies in Rochester, Syracuse and Utica. The Cooperstown exchange has about 250 'phones and the Richfield Springs exchange about the same number. In the towns about Cooperstown there are some 200 'phones of the Otsego Home Company. and these will be connected with the exchange at the county seat and given service from that point. The consolidation of these companies is a part of a general plan to combine for more effectually competing with the Bell Company.

The David City, Neb., telephone exchange recently passed into the hands of the Surprise Telephone Company. The exchange was built several years ago by F. C. Scott and conducted as an Independent exchange exclusively until about four years ago, when arrangements were made and it was connected with the Nebraska Telephone Company. The Surprise Company has since the first of this year, purchased the exchange of the Independent Telephone Company at Brainard. J. E. Keebaugh, formerly of Surprise, succeeds Mr. Scott as general manager of the telephone business in David City.

The new telephone system of the St. Louis County, Mo., Telephone Company, an Independent organization, has started in to cut rates and furnishes a 'phone in residences for $1.50 a month, and in business houses for $2 a month. While this system was built primarily to afford local communication, arrangements have been made whereby St. Louis connection can be secured by the payment of toll rates to the other lines. The 'phones work automatically, dispensing with the services of an operator.

Work on the new telephone line from Huntsville to Jeff, Ala., was recently commenced. D. E. Kelley, owner of the new line, promises a most excellent service to the people along the route.

Telephone Competition in Alabama.

The city council of Tuscumbia. Ala., has granted a 25-year franchise to John C. Montieth and associates of Chicago for the construction and operation of a telephone line throughout that city. It is the purpose of the gentlemen securing the franchise to erect an Independent long-distance line and also an Independent local line in competition with the Southern Bell, which has enjoyed an open field for several years in Tuscumbia, Sheffield and Florence.

Telephone System Reincorporated.

The South McAlester-Eufaula telephone system was lately reincorporated at South McAlester, I. T., with the following officers: William Busby, president; C. E. Foley, vice-president; L. H. Roberts, secretary; D. M. Hailey, treasurer. The company owns several hundred miles of telephone lines in Indian Territory, and will expend $50,000 in improvements, installing the central agency system instead of the present old-style system.

The directors of the Churchville, N. Y., Telephone Company have elected the following officers: President, W. L. Ormrode; vice-president, C. H. Briscoe; secretary, C. G. Stewart; treasurer, F. W. Potter. By general consent, an assessment of 20 per cent. has been levied on the capital stock. Two committees have been appointed, one on contract and right of way, and the other on construction. A special agreement was made that no shares should be sold except subject to the approval of a majority of shareholders. This proviso is a safeguard against any company or concern acquiring a controlling interest to the detriment of the company In matters of business in the regular board meetings each share of $100 is entitled to a vote.

The Glen Telephone Company has notified its subscribers in Gloversville, N. Y., and vicinity, that on February 1 the rates for local service are to be increased. It is said that the proposed increase causes a large amount of dissatisfaction among the subscribers, and that an effort will be made to force the company to rescind its action. The common council may be asked to take action in the matter, as it is believed that under the company's franchise it has no right to increase the charges. Officials of the company state that it is necessary to make the increase for the welfare of the business, as under the old rates there was no profit in the enterprise.

The Rich Hill, Mo., city council lately held a special session to receive a proposition from S. J. McComb, of Humansville, Mo., who proposed to put in a local telephone system, cable the wires, give the city 2 per cent. of the gross receipts and free municipal 'phones, providing a 20-year franchise is granted.

The Western Telephone Company of Big Springs, Tex., has filed an amendment to its charter increasing its capital stock from $15,000 to $30,000.

The Little Kanawha Telephone Company of Grantsville, W. Va., wants prices on electrical supplies.

Wayne Telephone Companies Unite.

The Wayne County Telephone and the Wayne-Monroe Telephone Companies have united. While there has been no merger or consolidation of the two companies, and while separate boards of officers and directors were elected and separate stock issues made arrangements have just been perfected whereby greatly to the mutual benefit of patrons and directors of both corporations, the two companies are now connected. The Wayne Telephone Company has existed in Lyons and the adjoining towns for some years. The lines of the Wayne-Monroe Company extended throughout the northern and western towns of the county and between the two there was no connection.

By the establishment of the union of the two lines, a telephone service from one end of Wayne County to the other. and with stations in Buffalo, Oswego, Syracuse, Binghamton and intermediate places is now in operation. These increased telephone facilities are bringing about the installation of hundreds of new 'phones throughout the county. In Lyons alone rush orders for telephones are going in daily, while throughout the county 1,100 machines have been established. In addition to the advantage of an entire Wayne County service and a greatly increased service throughout the State, the price of telephones per year has lowered and toll rates to any outlying district of a town are now given with the price of the 'phone. County Clerk Ledyard C. Cuyler and Sheriff Albert Yeomans are with others interested in the union of the two companies. of which John A. Driscoll is the general manager.

New Telephone Line for Missouri.

St. Joseph and Cameron, Mo., are now connected by three telephone lines. The Funston Long Distance Telephone Company lately opened the third line, and its wires are connected to the Central office of the Citizens' Telephone Company. The line is 40 miles in length. It follows the right-of-way of the Burlington to Cameron. About 1,500 subscribers, including the Cameron exchange, will be accommodated. Among the towns reached by the company are Stewartsville, Osborn, Hemple and Saxton. J. G. Funston, superintendent of the Citizens' Telephone Company, is secretary and general manager of the Funston Company. E. B. Funston of Racine, Wis., is the president.

The Dodge City Telephone Company is extending its line to Ford City and thence to Bucklin on the Rock Island, and with the line owned by the farmers in the southern part of the county it forms a network of lines covering nearly the whole of the southwest part of Kansas.

At the annual meeting of the Bergen, N. Y., Telephone Company the following officers were elected: President, G. M. Gillette; vice-president, J. S. Gleason; secretary, Holden Miller; treasurer, C. E. Housel.

W. H. Burke, of Clifton Springs, N. Y., and W. C. Ellis, of Shortsville, who have been interested in several telephone companies operating in Ontario County, have sold their interests to the Long-Distance Inter-Ocean Telephone Company of Buffalo.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Albuquerque, N. M.--A franchise has been granted to Joseph Barnett to build and operate an electric light plant in the city limits.

Appleton City, Mo.—The city officials are negotiating for a franchise with S. J. Culbertson, of Vandalia, whereby this city may have electric lights.

Arcanum, O.--A petition has been presented to the council asking for a vote of the people on issuing $35,000 in bonds for the construction of a waterworks and electric light plant.

Barberton, O.—A new electric lighting plant may be installed here.

Boyd, Wis.—The Cadott Electric Light & Power Company of this city is seeking a franchise.

Canadian, Tex.—The installation of waterworks and an electric light plant is being discussed. J. F. Johnson is chairman of the committee.

Frankfort, Ky.—The People's Electric Company has a contract to furnish the city with electric lights.

Freehold, N. J.—The Freehold electric light plant was recently sold with its franchises to P. A. V. Van Doren, of Princeton.

Georgetown, Ill.—A franchise for an electric lighting plant has been granted to John Searl, of Chicago. Work will soon be commenced.

Gorin, Mo.—J. K. Schackett and D. A. Frazee have been granted a 20-year franchise to erect an electric lighting plant here.

Hartford, Ky.--It is reported that J. W. Hale, of Fordsville, will build an electric light plant.

Jefferson City, Tenn.--The Jefferson City electric light plant was recently destroyed by fire. The loss is estimated at $4,000.

Kingman, Kan.—A petition will soon be presented to the city council asking that a franchise be granted to W. S. Grosvenor, giving him the right to establish and operate an electric lighting plant here.

La Crosse, Wis.—Dr. E. C. Swartout has filed an application for a franchise to furnish electric current and power in this city. This is the second application for a lighting franchise in a month to compete against the La Crosse Gas & Electric Company.

Lake Charles, La.—The city council has under consideration plans for the erection of an electric light plant, to cost about $60,000.

Marksville, La.—The question of levying a 5-mill tax for 20 years, for the purpose of installing a system of waterworks and electric lighting plant here was carried at the recent election.

Milwaukee, Wis.—The Milwaukee Electric Railway & Light Company's plant was lately destroyed by fire entailing a loss of $5,000.

Montgomery, Minn.—The Montgomery Electric Light & Power Company will be formed by S. A. Vopatek, and a plant installed at once.

Morrill, Kan.—A citizens' committee has under consideration a proposition to establish an electric light plant here.

Palmyra, N. Y.—The Palmyra Electric Light & Power Company has been sold to William J. Morris, of Penn Yan, who will immediately improve and repair the same.

Perth Amboy, N. J.—Alleging that the Public Service Corporation is unduly discriminating against this city, a number of local merchants are planning to form an independent electric light company and manufacture current for their own use. Some of those interested in the movement are Peter Floersch, Kelly & McAlinden, Sickles Brothers, Gannon & Sheehy, F. W Woolworth & Co., L. Briggs and S. M. Jacobsen.

Pitman Grove, N. J.—M. K. Treichler, of Philadelphia, Pa., who recently purchased the electric light plant here, proposes to improve and extend it.

Poplar Bluff, Mo.--W. B. Hays, W. H. Wiisey and D. P. Bacon have acquired the electric light plant and will make improvements.

Renton, Wash.—The Seattle Electric Company is planning to ask the city officials of Renton for a franchise to construct a branch of its system to this place, and furnish electricity at the rate of $1 for each light put in.

South Boston, Va.—The South Boston Electric Light & Power Company contemplates making extensive improvements to its plant, increasing the capacity, etc.

Sumter, S. C.—J. L. Alnut represents parties who propose building an electric light plant here. He has petitioned for a franchise.

Terre Haute, Ind.—The council has authorized the employment of expert electricians to assist in the investigation of the feasibility of establishing a municipal plant.

Uvalde, Tex.--This city is to have an electric light plant.--A franchise has been granted and the plant will be erected soon.

Waterloo, Ia.--The Waterloo & Cedar Falls Gas & Electric Light Company has been incorporated with a capital of $595,000, by Frank J. Fowler and others.

STREET RAILWAYS.

Akron, O.—The Northern Ohio Traction & Light Company will erect a line from this city to Cleveland and Canton.

Anderson, Ind.—Wallace B. Campbell, of this city, who is promoting an electric railway between here and Lebanon, by way of Noblesville, says that he has begun negotiations with a Chicago corporation that agrees to finance the road if satisfied with the results of an investigation.

Boise, Idaho.—Arrangements are being made for the erection of a trolley line to South Boise aross the Broadway Bridge.

Erie, Pa.—A trolley line will be erected connecting Cambridge Springs, this city and Pittsburg.

Elyria, O.—The Cleveland & Southwestern Traction Company's car barns were destroyed by fire. Loss is estimated at $20,000.

Grafton, W. Va.—The Grafton Railway & Light Company, with a capital of $400,000, has been incorporated by W. E. Horton, George W. Powell and others, to construct an electric railway and an electric light and power plant here.

Indianapolis, Ind.—Articles of incorporation have been filed at the office of the Secretary of State for the Central Electric Traction Company of Indiana, capitalized at $25,000.

Missoula, Mont.—The Amador Railway Company has been incorporated with a capital of $1,000,000. The system is to be electric.

St. Louis, Mo.—Local property owners are planning a new electric line to run north of this city and Ferguson.

Webb City, Mo.—H. M. Baker, of Carthage, has begun working to secure the right of way for the building of an electric line which is proposed. to be built from here to Oronogo, Alba, Neck and terminating at Carthage.

POWER PLANTS.

Muskogee, I. T.—It is reported that the Commercial Club contemplates developing the power of the Grand River, 10 miles from this city, and has engaged engineers to make surveys for the location of a power house.

Omaha, Neb.—The Baxter Springs Electric Power Company of this city, has been incorporated with a capital of $30,000 by E. T. McCarthy, R. W. Bailey and others, to operate an electric power plant.

Pittsfield, Mass.—The Pittsfield Street Railroad Company is considering a site for a new power plant, which it will build at once.

Rockingham, N. C.—Hugh MacRae & Co., of Wilmington, N. C., has purchased the Bluett Falls water power property on the Pee Dee River near this city. The company proposes forming a corporation to develop the water power, and build an electric light plant for transmitting electrical power to industrial enterprises within a radius of 20 or 30 miles. It is reported that 30,000 hp. can be obtained.

BIDS WANTED.

Camden, Ark.—The Camden Light & Power Company is in the market for two dynamos, one boiler, engine transformers and arc lamps.

Canadian, Tex.—The Canadian Gin & Milling Company wants prices on equipment for an electric light plant.

Columbia, S. C.—Engineer C. C. Wilson, of this city, will receive bids until February 15, for the construction of an electric light plant for Clinton, to cost $25,000.

Cropley, Md.—R. Scott Allen, of this place, is in the market for a new or second-hand 25 to 30 hp. engine.

Dallas, Ga.—The Dallas Light & Power Company wants to purchase a good second-hand 50 or 72-inch return tubular boiler.

Fort Snelling, Minn.—Bids will be received until January 21 at the office of R. N. Schofield, constructing quartermaster, St. Paul, for the construction of an addition to the electric system here.

Walla Walla, Wash.—Sealed bids will be received in triplicate until January 31 at the office of the constructing quartermaster in this city for installing interior conduit and wiring for electric lighting of two double barracks at Fort Walla Walla. Address Noble H. Creager, captain and quartermaster United States Army.

Washington, D. C.—The Department of the Interior will receive bids until January 24 for the construction of extensions to the water, sewer and electric lighting systems at the Riverside School, Cal.

Wilmington, N. C.—The Southern Electrical Company of this city is in the market for all kinds of electrical supplies.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅜@15½c.; Lake 15½@15⅝c.; casting, 15¼@15⅜c.

Electric Storage Battery was strong in Philadelphia on Monday, advancing 1½ points.

Copper prices were advanced ⅛ cent per pound all along the line on Monday.

The stockholders of the Brooklyn Rapid Transit Company will hold their annual meeting on January 27.

Interborough Rapid Transit stock made a gain of 20 points in this city last week. The stock is on a 6 per cent. basis.

J. P. Morgan & Co. will act as managers of the $36,000,000 syndicate formed to reorganize the Chicago traction companies.

The preferred and common shares of the Boston & Worcester Electric Companies have been listed on the Boston Stock Exchange.

A dispatch from Newark, N. J., says that the Interborough Company is about to take over the trolley system of the Public Service Corporation.

The directors of the Edison Electric Illuminating Company of Boston have declared a regular quarterly dividend of 2½ per cent., payable February 1.

The American Graphophone Company has declared the regular quarterly dividend of 1⅜ per cent. on its preferred stock, payable February 15 to holders of record February 1.

The Metropolitan Street Railway Company of Kansas City carried 40,000,000 people the past year and its gross receipts were close upon $2,000,000. Its net income was a little over half this amount.

A pool has been made in Cleveland of the remaining assets of the Everett-Moore syndicate. The bankers' committee, controlling them, it is stated, will completely satisfy all remaining creditors.

A loan of $10,000,000 to the Philadelphia Rapid Transit Company is being negotiated, the money to be used to complete the Market street subway in that city. It is said that Drexel & Co. will probably take the loan.

At a recent meeting in Philadelphia of the directors of the Electric Company of America they increased the semi-annual dividend on the stock of the company to 3½ per cent. from 3 per cent., thus putting the issue on a 7 per cent. basis.

The directors of the Marquette County Telephone Company of Ishpeming, Mich., have declared an annual dividend of 10 per cent. The company is an independent concern, composed of local men, and gives the Bell people stiff competition.

There was marked strength in the electric issues on the New York Stock Exchange Monday. General Electric advanced 2⅛ points and Westinghouse went up 3½ points. Several thousand shares of each were traded in, but there was no news to account for the rise.

John J. Mitchell, president of the Illinois Trust & Savings Bank, has made the first official statement as to what the new Morgan-Field-Mitchell traction syndicate is prepared to accomplish. As spokesman for the syndicate he asserted that $36,000,000 had been raised to control the Chicago City Railway Company. "Negotiations will be taken up with the city for renewal of the franchise on the basis of one company, one fare," he said. "When an agreement is reached the companies under the control of the syndicate will be merged to carry out the provisions of the ordinance."

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Jan. 16
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	169½
Metropolitan Street Railway	117½
Metropolitan Securities	76½
Ninth Avenue	197
Third Avenue	130
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	63⅛
Interborough Rapid Transit	185
New Orleans Railway	3
Public Service Corporation (New Jersey)	140
Philadelphia.	
Consolidated Traction of New Jersey	80⅛
Philadelphia Traction	99⅛
Union Traction	58⅜
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	13½
do. do. do. pref.	59¼
West End Street, com	95
do. do. do. pref.	113
Chicago.	
City Railway	197
North Chicago	85
Union Traction, com	11⅞
do. do. pref.	49
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	16
do. pref.	76⅜
Electric Boat, com	40
do. do. pref.	85
Electric Lead Reduction	⅛
Electric Vehicle, com	14
do. do. pref.	24
Westinghouse, com	183½
do. pref.	195
General Electric	190¼
Boston.	
Edison Electric Illuminating	252
General Electric	190⅛
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	41¼
do. do. pref.	113
Philadelphia.	
Electric Company of America	11⅛
Electric Storage Battery, com	78
do. do. do. pref.	78
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	146
Western Telephone Company	18¼
New England Telephone Company	140
New York.	
American Telegraph & Cable Company	93⅛
Commercial Cable Company	210¼
Mexican Telephone Company	2
New York & New Jersey Telephone Company	158¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93
Chicago Telephone Company	143
MISCELLANEOUS STOCKS.	
Otis Elevator Company	49
Consolidated Car Heating	64
Standard Underground Cable	200

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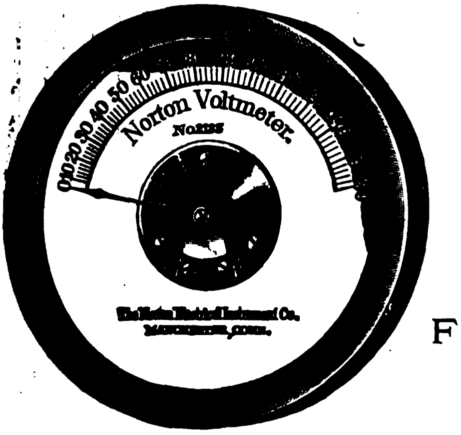
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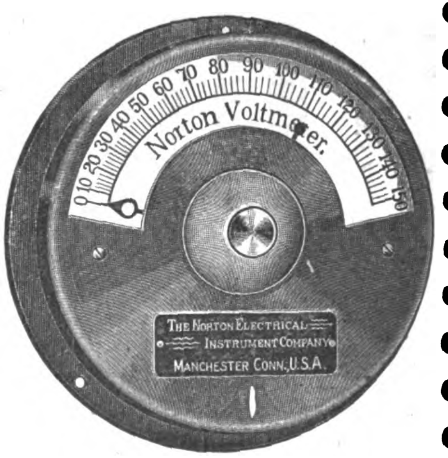
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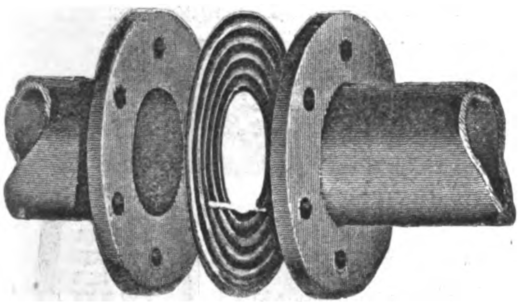

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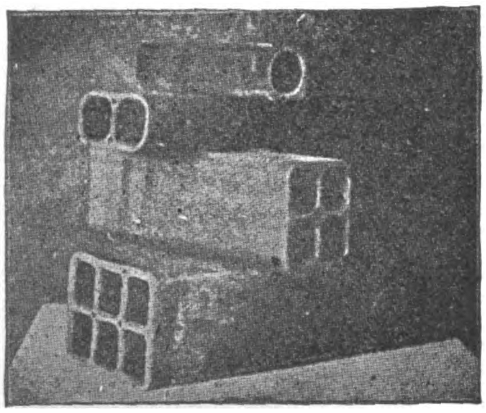

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EDITORIAL NOTES.

Rapid Transit in Brooklyn. Rapid transit in Brooklyn does not mean the Brooklyn Rapid Transit Company. Why conditions in the sister city to New York should have been allowed to fall into such a deplorable state can be best explained by the general apathy, or—to use a better expression—resignation, into which the other half of Greater New York has fallen in the last decade.

The stimulation given to public interest by the opening of New York's Subway has forced the board of directors of the Rapid Transit Company to the conclusion that the rehabilitation of the plant, which may mean an expenditure of $20,000,000, is the only way out of a problem bristling with difficulties. Brooklyn is New York to-day—although when the surface and elevated systems were first projected it represented a distinct municipality. Since that time the traction system has been patched and extended and brought into New York over the bridge. Glaring defects became evident when the rush hours began, and Brooklyn people found out that the years of their lives were too precious to be spent traveling in overcrowded, underheated, snail-like "trolleys." Public condemnation is like a blast from Gabriel's trumpet to the sluggish ambitions of heavy stockholders. It gains weight and force and threatens the very life of corporate interests. This has been the case with the street railway company of Brooklyn. It is now about to initiate changes which, it is anticipated, will transform the character of the outcry from criticism to commendation. In the meantime the subway is being pushed to Brooklyn through tunnels under the East River and New York Bay.

With a $20,000,000 expenditure about to be made to improve the surface system, and a subway rapidly nearing its completion, the people of Brooklyn may soon find more comfort in traveling in their own city than we in this over-congested borough on the other side.

* * *

The Telephone Monopoly. Elsewhere in this issue will be found an excellent account of the Telephone Trust's history in this city. Almost every year there is talk of "exorbitant rates," how "the Legislature will enact a law controlling rates," how the "people are being robbed," etc., etc., and yet nothing has been accomplished. The "Herald," which is now fighting the Telephone Trust, states that facts and figures are to be laid before the Legislature which the advocates of relief from the exactions of the telephone monopoly in New York City hope will compel action by the lawmaking body of the State. The paper further says that investigation is now being made by one of the foremost experts in the country, and that the discoveries so far made are of a character to make telephone reform almost inevitable, unless influences are brought to bear to prevent it.

For the past 10 years or more these influences that the "Herald" speaks about have annually been brought to bear, and the chances are that they will again be sought for. It should be borne in mind that in seeking more just and equitable telephone rates for this city, that both political parties have to be reckoned with and the New York Telephone Company is very friendly, and has been for years, with both parties and especially with the Republican organization, which usually controls the Legislature. As a result all of the bills looking to cheaper telephone rates that have been introduced at Albany, have invariably been "laid on the table,' and lost or buried in a pigeon hole. Let us hope the bills this year will not share a like fate.

* * *

The Safety of Electric Plants. By some peculiar means of reasoning the tradition gained ground that electricity is a dangerous thing to meddle with, and the public satisfied for a time, as many are to-day, with the truth of this proposition, gazed with apprehension upon the rapid developments taking place in this sphere of activity. The electrician was and is regarded as a wizard, with a certain mysterious power of control over elusive forces, and this idea, perhaps, aided by the statements and sensational experiments of charlatans, has led to a belief, more firmly founded in the old than the new generation, that electricity only represents shocks, burns, death and fire. The exact manner in which it may be used for electric lighting, for the operation of motors, or the running of electric car systems has not as yet found its way into the layman's mind. Neither an abstract nor a concrete idea exists there in this respect. That which happens is unfortunately accepted as it stands, and an active interest is only manifested when, to use a popular expression, the car or lights cease to operate because "a fuse blows." It is hard for the great mass of bread winners to realize that their personal safety is greater in a building lit by electricity than one lit by gas; that an electric car is by far a safer, healthier and better controlled vehicle than one operated by steam or any other fluid. And finally, aside from other considerations, the risks from fire belong to such a category, that the insurance people believe a building wired with up-to-date methods is the best risk on their books. This, of course, leads us to a consideration of the electric plant as a whole. What degree of safety can be guaranteed in connection with it? What part of such an equipment can be regarded as the most susceptible to the influence of destructive changes? The natural and logical answer to the last would be the boiler, and to the first a correct answer would be framed in these words:

The degree of safety that can be guaranteed in connection with an electric plant consisting of boiler, engine, dynamo and wiring is largely dependent upon the care of the boiler and engine. It rarely happens that well installed wiring, "iron conduit" as it is called, gives or can give any trouble. The risks of fire here are at their lowest possible figures. The dynamo is similarly not susceptible to change unless it is heavily overloaded or neglected as regards oiling, etc. A well made engine represents more risks in this respect, although in the hands of a careful man they also are reduced to a minimum. What is left and is acknowledged as the greatest source of danger is the boiler. The boiler inspecting and testing commission, to a large extent, have this responsibility on their hands, yet the engineer must see that the boiler is kept clean and the safety valve is always operative at the set pressure. These facts remove all doubt as to the safety of electric plants, particularly the electrical part, and show that a well-paid, well-trained and intelligent engineer is the only one fit to discharge the duties required of him. In such hands the safety of electric plants is assured and it would be almost epigrammatic to state that "the safeness of electric plants is the safeness of those in charge of them."

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

In the six days last week that the doors were open for the automobile show in this city 60,000 men and women paid admission fees, and the 82 exhibitors sold automobiles worth nearly $1,000,000.

◆

The press agent of the General Electric Company says "it is so crowded with orders that it is compelled to turn over many contracts to the Westinghouse Company."

◆

Mr. Guillermo A. Puente, one of the Government engineers of the Argentine Republic, was in Baltimore last week inspecting the machines of the Rowland Telegraphic Company.

◆

Chicago's fourth annual automobile show will be held from February 4 to 11.

◆

The City Council of Cleveland, O., has authorized the Cleveland Electric Railway Company to begin an experimental service to determine the profitableness of a three-cent fare within a radius of two miles from the center of the city. No transfers will be given on the three-cent cars. The street car company has the right to abandon the experiment at its discretion.

◆

Opposing the opinion of Dean Hutton, of Columbia College, New York, who said that some of the students had "really stolen their degrees," Prof. George F. Sever, of the department of electrical engineering at the university, has given it as his testimony that the "outside talk about the honesty of Columbia students is false." Prof. Sever, in speaking to one of his classes, said: "Absolutely no unfair means are employed by the students in the school of applied science. The students should resent such attacks as are aimed against Columbia. Honesty at Columbia is at a higher standard than at most other universities."

◆

The 193d meeting of the American Institute of Electrical Engineers will be held at the Chapter Room, Carnegie Hall, 154 West 57th street, New York, on Friday, January 27, at 8:15 P.M. The subject selected for this meeting is "Central Stations." The following papers will be presented and discussed: "Acyclic (Homopolar) Dynamos," by J. E. Noeggerath; "Modern Central Station Design as Exemplified by the New Turbo-Generator Station by the Edison Electric Illuminating Company, of Boston," by I. E. Moulthrop.

◆

The National Electric Light Association at its last meeting in Boston changed the by-laws so as to admit as individual members professors of engineering, chemistry and physics. Mr. Henry L. Doherty, chairman of the committee on membership of the association, is now inviting these educators to join the association and requests members to send him the names and addresses of such instructors.

◆

Electrical Inspector H. J. Blakeslee of the Hartford (Conn.) Board of Fire Underwriters in his annual report says that the increase in the use of electricity in Hartford during the last few years has been 54 per cent. Out of 231 fires in Hartford in 1904, only 6 were electrical, and the average for three years was only 1.9 per cent. Many of the fires were caused by the carelessness of gas plumbers in handling and tampering with electric lighting circuits they came across in their work.

◆

The New York "Times" says "there seems to be some sort of a spell upon the municipal ownership people that prevents them from so keeping their books as to show the exact financial results of their operation. This is not less to be lamented by those who hope to find in such ownership of public utilities a remedy for many existing evils than by the antagonists of the hopeful ones, who think the plan dangerous and chimerical."

NEW YORK CITY TELEPHONE HISTORY.

(From the New York Herald).

Hitherto sincere efforts to invade the metropolitan field of the Bell telephone monopoly have invariably met with disaster. Men who were so presumptuous as to embark in such an enterprise have usually discovered that the Telephone Trust has a long arm, a crushing grip and that it can mould men and things to its will.

Many competitive schemes have been exploited in New York City within a decade. Time and again the newspapers have told of the incorporation of this company or that which purposed an immediate attack upon the Trust in its metropolitan stronghold. Promoters of such companies have given out rosy prospectuses, predicting the cutting in half of telephone rates in New York. Some of these enterprises were undoubtedly genuine, and their backers attested the sincerity of their motives by losing thousands of dollars before they finally yielded. Others were organized with little better purpose than to sell out at profitable terms to the monopoly. Those that lacked the elements of formidable competition the Telephone Trust has discreetly ignored. The few that developed dangerous strength the Trust either has crushed or crippled by some of the many insidious methods in which the Bell monopolists are experts, or else, if its franchises and other assets were really valuable, the Trust has usually managed adroitly to acquire them or so to dominate them as to make them subservient to the purposes of undisputed monopoly.

We will undertake to sketch briefly the rise and fall of one of the most ambitious of these competitive enterprises, the Telephone, Telegraph & Cable Company of America. That corporation, beset by litigation, with its once aspiring capitalization of $30,000,000 shrunk to $9,000,000, maintains at least a nominal corporate existence, with an office at No. 100 Broadway. But it is innocuous so far as the Bell monopoly is concerned and the Trust regards its present situation with complacency.

Its president to-day is Henry S. Kearny who was Mayor Van Wyck's Commissioner of Public Buildings, Lighting and Supplies, who has maintained close and friendly relations not only with Tammany but also with the Bell telephone interests, who when a commissioner and in control of the city's underground electrical conduits was questioned before the Mazet Investigating Committee concerning the difficulties experienced by independent companies in getting permits to utilize those conduits, and who since becoming the official head of the Telephone, Telegraph & Cable Company of America has refused to deny the published and generally accepted statement that that unhappy corporation is now wholly in the toils of the Bell Telephone Trust.

One of the competitive enterprises which doubtless had genuine, serious intentions of invading the New York City field several years ago, was the old Knickerbocker Telephone Company, which was organized as an operating company to do business in New York City. It had behind it substantial interests and its general manager and afterward its president, Gen. William H. Eckert, brother of Thomas T. Eckert, of the Western Union Telegraph Company, worked hard for its success for many years, though without any marked degree of substantial public support. The Knickerbocker Company, however, had acquired franchises and privileges, which made it a factor to be reckoned with.

Its permit to use the Manhattan electrical undergound conduits had been granted seemingly with little difficulty in the official incumbency of Commissioner Kearny, and that, too, at almost the identical time when Mr. Kearny was being hauled over the hot coals of the Mazet investigation by Frank Moss and the present Judge Clarke, who were counsel for that legislative committee. They wanted to know why it seemed to be impossible to obtain a subway permit in behalf of the People's Telephone Corporaton, an independent company organized by Darwin R. James and other prominent members of the Board of Trade, which latter organization had been for years fighting the Telephone Trust in Albany for a reduction of its extortionate rates. When on the stand Commissioner Kearny excused the apparent holdup of the People's Company's permit by petulantly asserting that Mr. James' corporation was organized solely to sell out to the Trust, but the permit afterward was granted to the People's Company, as well as to the Knickerbocker.

In the meantime the Erie Telephone Company had been making marked headway in operating an independent telephone service, with valuable franchises, extending westward from Erie along the line of the great lakes, cutting into the Bell monopoly's profits at many important points, and the Boston & New York Telephone Company, with certain operative rights in Boston and elsewhere, was looming up as the possible independent factor, not only in a competitive system throughout New England, but also as the projected link in a competitive line between Boston and New York.

This was substantially the telephone situation when certain ambitious capitalists conceived the idea of incorporating the Telephone, Telegraph & Cable Company of America as a holding company to acquire the control of various independent operating companies. In November, 1899, with a capitalization of $30,000,000, divided into 600,000 shares of a par value of $50 each, the Telephone, Telegraph & Cable Company was incorporated in Trenton. The incorporators were William J. Latta, who for years had been general agent of the Pennsylvania Railroad Company, and who became the president of the new corporation; Martin Maloney, of Philadelphia, chief promoter of the enterprise, and commonly known in Philadelphia as a useful agent of the Whitney-Elkins-Widener interests, and James E. Hays, of Camden, N. J., who was said to be a legal representative of the same syndicate of capitalists.

It was announced with some ostentation that the power of the Whitney-Widener-Elkins combination was enlisted in the new enteprise, and that at last relief from Trust oppression was in sight. John E. Mack, of Philadelphia, wealthy, and president of the Keystone Telephone Company of that city, which was then and still is maintaining an independent service, came into the scheme, and many New York men, such as Frank Tilford and Henry R. Wilson, president of the Lincoln Trust Company, whose sincerity could not be doubted, took an active interest in the proposed coalition, and were afterward members of the board of directors.

For a time the affairs of the Telephone, Telegraph & Cable Company went swimmingly. The various operating companies with their rights and assets, were absorbed by the holding company and the new combination appeared distinctly formidable. But presently there appeared published denials of the assertion that the Whitney-Widener-Elkins-Ryan syndicate was the backbone of the concern. Martin Maloney, the promoter, remained conspicuously active, but it was announced that the wealthy capitalists with whom his name was usually associated, had found they had "other interests," which were not exactly in harmony with the interests of the Telephone, Telegraph & Cable Company, and that while they would not entirely hold aloof from the enterprise, their names should not be identified prominently with it. The affairs of the big competing corporation began to look less rosy.

Acquisition of the Knickerbocker, the Erie and the other operating companies considered essential to the enterprise had been costly. Assessments were called for from the subscribers to the stock of the holding company. Dissatisfaction was evident among many of them, and there was talk of mismanagement and the need of reorganization.

John E. Mack, of Philadelphia, who had paid in $100,000, and had subscribed to $500,000 of the stock, withdrew his support, and litigation involving those sums is still pending between Mr. Mack and the company.

William J. Latta remained the company's president until early in 1901, when he was succeeded by the late Judge James M. Thomas, of Cleveland, who was president of the Independent Telegraph System of America. The board of directors was reorganized and in April, 1901, the company reduced its stock capitalization to $9,000,000, by reducing the par value of the shares from $50 to $15 each.

With more or less friction and dissatisfaction, and with the prospect of further assessments upon the stockholders to meet necessary expenses, the company drifted along until midsummer. Then, at the psychological moment, a new and masterly figure came upon the stage and took his place in the limelight.

It was Charles W. Morse, the same Mr. Morse who had been the head and front of the American Ice Trust, the intimate personal and business friend of the high men of Tammany Hall, the buyer of banks by wholesale, including the New Amsterdam, the Garfield National and the National Bank of North America; the buyer of steamboats and of corporations, and just now the central figure, though personally in Europe, in the interesting imbroglio commonly known as the Morse-Dodge-Gelshenen mystery.

Mr. Morse, seeing another opportunity for a brilliant financial stroke, offered to buy outright the Telephone, Telegraph & Cable Company of America if a majority of the stockholders would consent to sell out at 50 cents on the dollar.

At this stage of affairs it was announced that some of the stockholders had not thus far made any payment on the second and third stock assessments, but the amount actually paid in aggregated about $4,000,000, so that Mr. Morse's offer of 50 cents on the dollar would involve cash payments by him in exchange for at least two-thirds of the stock of a sum ranging between $1,334,000 and $2,000,000.

Wearied and drained by assessments, the stockholders jumped at the offer. In the following September Mr. Morse found himself in absolute control of the Telephone, Telegraph & Cable Company of America. On October 14 the old board of directors retired and Mr. Morse substituted one headed by himself and consisting largely of either personal friends and business associates or officials of some of the various national banks in the chain of those institutions controlled by him. To some who were disposed to demur Mr. Morse asked that they serve as a personal favor to him, assuring them that their names were wanted "only temporarily."

Judge Thomas, who remained as president and who at that time was also president of the Knickerbocker Company, at the close of the meeting at which the new board was installed said hopefully:

"It is the intention of the Boston & New York Telephone Company, which is one of the constituent companies of the Telephone, Telegraph & Cable Company of America, to proceed vigorously with the completion of the line between New York and Boston. At the New York end we have completed the line as far as White Plains, while in Boston the work has proceeded to a satisfactory extent. It is impossible to tell just when the line will be finished between the two cities, but the work will proceed without delay. .

"As for the Knickerbocker Company, we fully expect to be in operation in the Borough of Manhattan within 12 months, but probably only in the lower part of the city, perhaps below 8th street. The system, however, will be rapidly extended. We shall operate through the Empire Company's subways and we intend to introduce many improvements in telephone service."

More that three years have elapsed since Judge Thomas made these predictions. He probably believed them when he made them and the public accepted them and hailed Mr. Morse as the pioneer of a new era in telephone competition. But these predictions have singularly failed of fulfillment. Judge Thomas retired as president and was succeeded by Henry S. Kearny, who still serves in that capacity, occupying in solitary grandeur and without evidence of clerical or other assistance an upper floor room at No. 100 Broadway, over the door of which appears the name "Telephone, Telegraph and Cable Company of America."

Mr. Morse's board of directors, headed by his own name, has also retired in a body. The present directorate consists, according to the Directory of Directors for 1904, of "Louis Baust, J. R. Burnett, James E. Hays, Henry S. Kearny, R. B. Kerr, Paul F. Lorzer, John E. McDonald and F. C. Purchase."

If the company has ever operated between New York and Boston since the advent of the Kearny regime New York has not heard of it. Its wires in Mount Vernon were torn down last winter. Before Mr. Morse went to Europe some of his acquaintances who thought his telephone purchase had been made at pretty stiff figures, said to him: "Morse, I hope that was not two millions of your own money you gave for the Telephone, Telegraph and Cable Company."

Mr. Morse smiled shrewdly and closed one eye ever so little, but he made no other reply. Since then the assertion has been made in print by a conservative evening newspaper that the Telephone, Telegraph and Cable Company of America has passed into the control of the Telephone Trust.

SUPPORTS FOR MAIN STEAM PIPES.

BY W. H. WAKEMAN.

Main steam pipes are frequently supported in such careless and indifferent ways that the subject calls for more attention on the part of those engaged in such work. If such pipes were always cold or hot, th[illegible]d be much more simple, b[illegible] cold, consequently are [illegible]ir shortest length. As steam is supplied their temperature arises and expansion increases their length, thus making the problem of their proper support much more complicated than it otherwise would be.

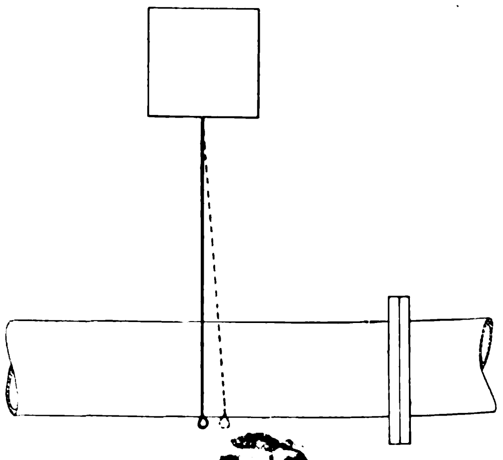

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Fig. 1 illustrates a plan very commonly adopted for this purpose. It consists of welding a lag screw on one end of an iron rod and forming an eye on the other. Two of these are screwed into a floor timber and a rod is passed through the eyes, also through a rough iron roller on which the pipe rests.

The pipe is supposed to turn this roller as it increases in length, but it seldom does because the roller is too rough, while the supporting rods are not stiff enough to retain their original position. The full line in Fig. 1 shows the position of hanger when pipe is cold. If it was stiff enough to retain this position, no trouble would result; but as a rule a hanger of this kind is not, therefore it swings into the position shown by the dotted line, the effect of which is to raise the pipe slightly, thus throwing it out of line and bringing strain upon it unequally.

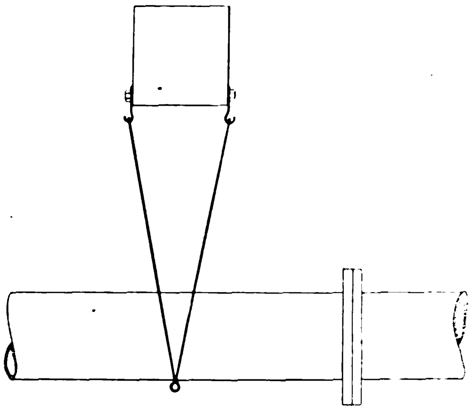


Fig. 2.

Fig. 2 shows a better arrangement, not only because a pair of hangers on each side are stronger than one, but each acts as a brace to prevent the swinging action illustrated already. This answers very well where the pipe is near the ceiling, but if it is a large pipe and is several feet from the floor timbers, Fig. 3 is better. This is not only very strong but is well braced, thus compelling the roller on which the pipe rests to turn as the metal expands.

Fig. 4 is a sectional view of a roller as frequently found in service. It is a rough casting just as it came from the foundry, therefore it does not turn easily, and when forced to turn it is higher in some positions than in others. If it was bored and turned until round inside and outside, it would operate much better, as it would turn easily and when it moved the pipe would not be thrown out of level. It is not expensive to machine these as described because they are cored out, as shown in Fig. 5, therefore only a small part of each requires boring. As these rollers bear on the ends only of the supporting rods, the latter are not sprung as much by the weight as they would be were the bearing at the center.

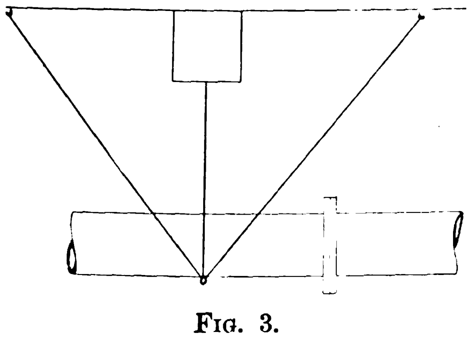


Fig. 3.

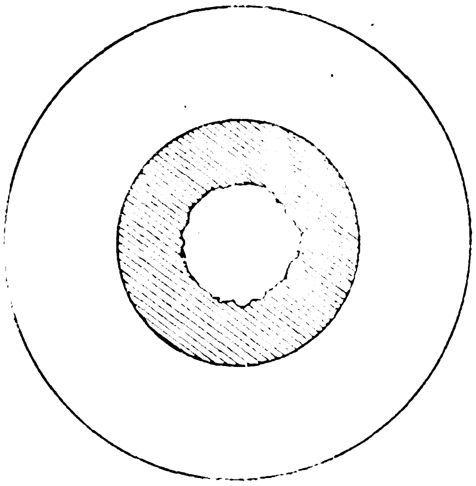


Fig. 4.

Fig. 6 is an end view of the pipes shown in previous illustrations. In some cases the pipe covering is carried up against the rollers, making it impossible for them to turn, even if all other conditions were right for free movement, which is a defect that should not be allowed.

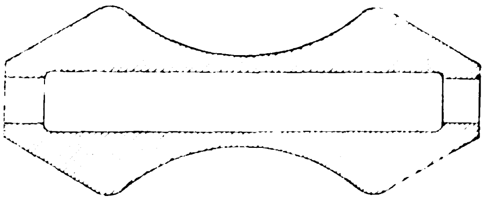


Fig. 5.

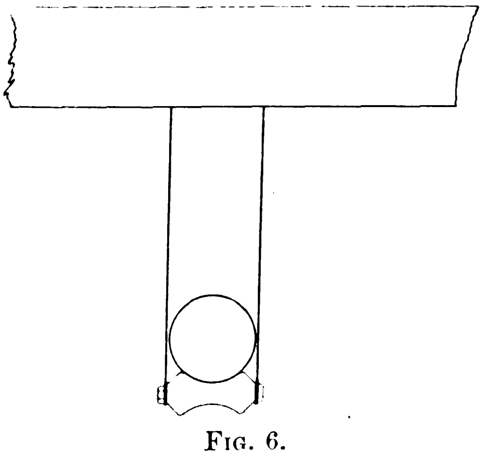


Fig. 6.

Where a pipe is located near a brick wall it may be carried on brackets, as illustrated in Fig. 7. These brackets should be made of wrought-iron and well braced. The iron ought to be from 4 to 6 inches wide to prevent the expansion of pipe from throwing it out of its proper position at right angles to the wall.

A suitable bolt holds the upper part of this bracket in place, while a short stud is sufficient for the lower end. I have noticed that some men think the latter requires a bolt as much as the former, but this is not correct, for the weight of pipe presses the lower part to the wall, only calling for a stud to prevent it from being accidentally moved out of place.

Fig. 8 illustrates a large pipe supported on brick piers where it can be carried near the ground. It shows one defect, which I have noticed in practice, as the rod is not supported close to the ends of roller, therefore the weight of pipe springs it out of place. This causes the roller to bear on its extreme ends only, resulting in very unsatisfactory service.

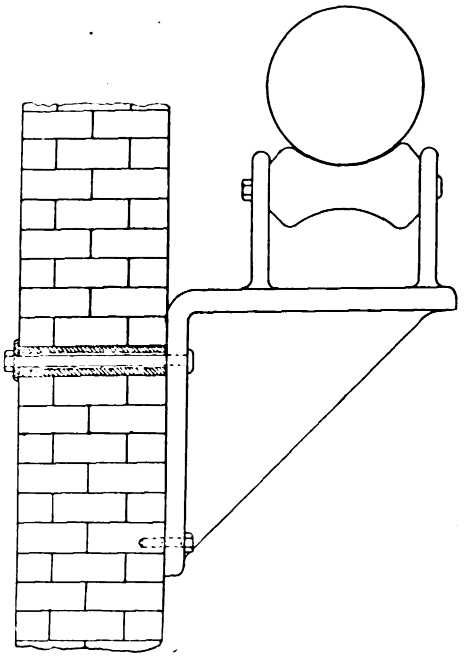


Fig. 7.

Fig. 9 shows an improvement along this line, as the rod is supported so closely that there is no chance for it to be deflected. All points considered, this is the best possible plan for supporting large and heavy pipe, as it is rigid on the foundations and at the same time allows the pipe to move easily in either direction as it is heated and cooled.

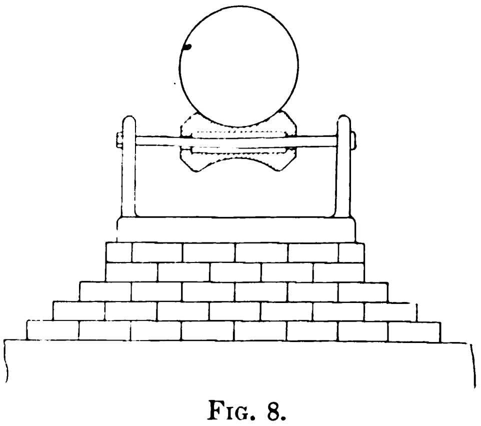


Fig. 8.

It is claimed that this is a class of rough work that does not call for special care, but this is not a correct idea, for although it does not require a nickel-plate finish it is necessary for it to be based on correct principles or trouble will follow. In hundreds of cases steam pipes leak badly, wasting away many dollars' worth of heat, and the engineers in charge find it impossible to keep the joints tight. Sunday may be the only available time in which to make such repairs, and in many cases only a part of this day can be spared, as the writer knows by experience, consequently if all joints are tight on one Sunday several may be leaking in two or three days, and perhaps all of them cannot be repaired on the following day of rest (?).

Why do some plants give so much trouble along this line while others are always in good repair? If first-class pipe and fittings are used and all pipe lines are properly supported, there will be no cause for complaint. It naturally follows that if good material is used and leaks are much in evidence, the trouble is due to unevenly supported pipe lines. I have assumed that the work was done by intelligent and honest mechanics in all cases, as that is the only basis for comparison.

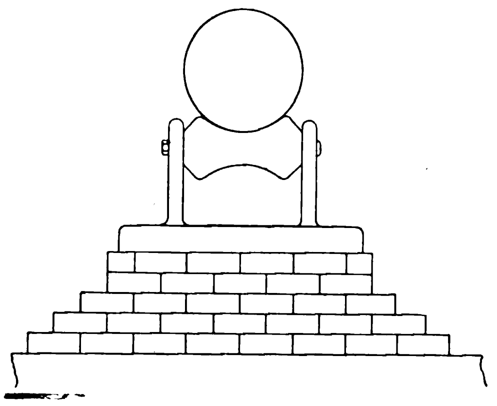


FIG. 9.

Due attention to suggestions made in this article will show that a pipe line must not only be put up level when cold but provision must be made for keeping it level when hot. The extra first cost necessary to secure the above desirable conditions is not worth considering when we note the money saved by their operation in practice. Dollars disappear very fast when there are many leaks in steam pipes under high pressure, and when the cost of hiring steam fitters to work nights, Sundays and holidays is added, the expense is great; therefore every reasonable precaution should be taken to avoid it.

The rollers shown in these illustrations are large in proportion to the pipes, but they are made so intentionally, because the larger they are in diameter the easier they move in service. Some rollers are too small to give good results, therefore this fault should be avoided.

ELECTRICITY LEAFLETS.

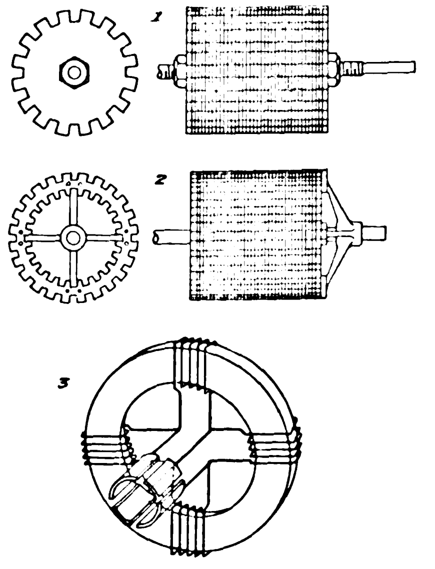
BY NEWTON HARRISON, E. E.

THE DYNAMO.

The Magnets of a Dynamo.—The three important parts of a continuous current dynamo are the armature, commutator and field magnets. The commutator is not required for an alternator. Around the armature core conductors are wound and firmly secured, their terminals ending in the commutator. Both commutator and armature are mounted on one shaft, by means of which the conductors are rotated in a magnetic field provided by the magnets. In some dynamos the coils of the magnets act almost directly on the armature, the magnetism passing through the end of the core which is curved to conform to the cylindrical shape of the armature and at the same time to permit it to rotate freely. In other dynamos the core is attached to a pole piece which may be of the same metal as the magnet core. If not, the core is generally of wrought-iron and the pole pieces of cast-iron. The ultimate purpose of the magnet winding is to force a certain amount of magnetism across from one pole piece to another. In order to get across, the magnetism must pass through the air-gap existing between one pole piece and the armature core and then again from the armature core through the air-gap back to the other pole. It is of the greatest advantage in a continuous current dynamo for incandescent lighting, for the magnetism, speed and armature turns to co-operate so advantageously that the volts produced by the machine for outside use remain unchanged.

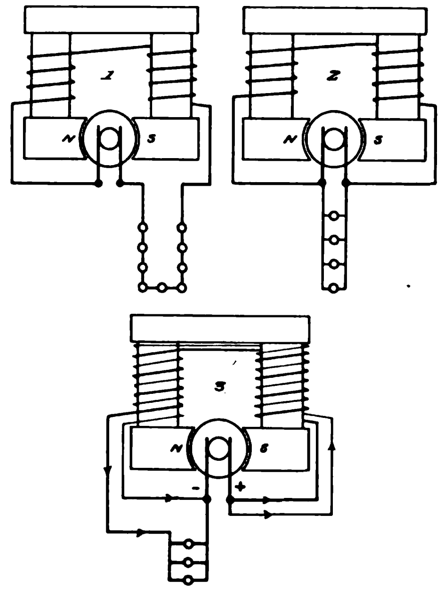
Construction of the Armature.—The armature core is not composed of a solid cylinder of iron; on the contrary, it consists of a great number of thin sheets of wrought-iron bolted together to give mechanical rigidity. If the armature was not composed of laminæ in this manner, it would act as a solid conductor moving in a powerful magnetic field and in consequence would generate a strong current. The effect of this current would be intense heat and a great waste of energy. Foucault was the first to suggest and to try the effect of subdividing the armature core at right angles to the lines of force in which it rotated. This practice is now followed out universally and is termed "lamination." The sheets of iron are stamped and in some cases thin paper is placed between the laminæ, although experience has shown that a coating of varnish or the oxide of the iron itself is all that is necessary to prevent electrical contact between plate and plate. Originally the conductors of direct current dynamos were wound on the outside of the core and held in place by bands of wire, but progress has been made both theoretically and practically by Pacinotti, and the armature cores are now slotted and the wires are wound in these slots and held, either by means of bands of brass wire surrounding the armature or by the employment of fiber strips slipping into and held by these slots over the wire they contain.

Kinds of Armature Cores.—Armature cores may be either simple cylinders, which have the wire wound completely around them, or they may be hollow inside and represent what are called ring and disk armatures. Both of these last named armature cores have the wire threaded through them instead of around from one side to the other across the ends. The cylindrical core is called by the name of "drum" armature and the ring by the name of "gramme" armature. The disk armature is sometimes called "the flat ring," to distinguish it from the other which is cylidrical in its character. Ring armatures are mounted on the shaft by means of spiders to secure them against slippage and vibration. The question of speed must be carefully considered in the construction of armatures and their mountings. The most solid type of armature and one largely in vogue at present is the drum. In the ring armature the conductors are wound around the ring; the consequence of this is that the inside wires are not generating electromotive force. In the drum armature the end wires crossing both bases of the cylinder are inactive and do not generate electromotive force.



1—Plate and complete core of a slotted drum armature. 2 Plate and complete core of a slotted ring armature. 3—A flat ring or disk armature.

Types of Dynamo Windings.—The manner in which a dynamo begins to generate EMF. is best understood with reference to the method of winding the fields and connecting them to the armature. There are three general types of dynamos, bearing the names of series, shunt and compound, according to their windings and connections. In the series dynamo the current generated in the armature flows out into the outside circuit, generally of lights, and returns to the dynamo through the winding of the fields. The circuit is therefore completed by the armature, lights and field being *in series* with each other. The shunt dynamo operates differently, the current from the armature passing through the outside circuit and returning to the armature, the field taking its current independently from the armature terminals or *in shunt*. The compound wound dynamo represents a combination of these two windings. It has a shunt field which takes its current from the armature terminals and an auxiliary series winding through which all the current of the machine passes in series with the entire outside circuit.



1—Connections of a series wound dynamo. 2—Connections of a shunt wound dynamo. 3—Connections of a compound wound dynamo.

Generating the EMF.—When a series, shunt or compound wound dynamo is set into operation, the action by which EMF. is developed and a current thrown into circulation does not take place instantaneously. The process is a self-regenerative one and depends in the first stage of its growth upon the presence of *residual magnetism* in the iron core and pole pieces of the machine. The least trace of magnetism in the pole pieces will enable the armature to generate a little EMF. This EMF. will send a minute current through the magnet windings, whether it be a shunt or series wound machine. The effect of this current is to produce a little more magnetism in the magnets and thus supply more lines of force to the armature to cut for the generation of more EMF. With more EMF. a stronger current circulates through the magnet windings, continually augmented in strength by the reinforcements of EMF. from the armature until a climax of development is reached when the dynamo is delivering its normal pressure. The process cannot go on indefinitely because the iron will not produce more than its proper quota of lines of force, and neither the speed nor conductors change in numerical value. Therefore when the iron becomes saturated and the speed and conductors remain unchanged the EMF. will not vary. It must be understood, however, for future reference that if any one of these three items undergo a change a corresponding change will be experienced in the development of EMF. A dynamo which can increase or decrease its magnetic field will proportionately affect the volts produced. If by any means, the speed remaining the same, the effectiveness of the conductors can be controlled in a dynamo, in like manner the EMF. will undergo increase or diminution.

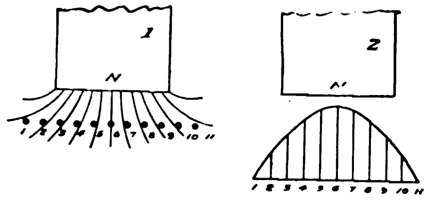
The Alternator.—The alternating current dynamo generates a current which cannot be used for exciting a magnetic field in the same manner as a current produced by a direct current machine. The electrical energy of an alternator consists of a rapidly reversing EMF. and current. The positive and negative poles of the dynamo are constantly reversing and the number of alternations per second depend upon the speed of the armature and the number of magnetic poles the conductors move past per second. The magnetic field is obtained from the current of a small continuous current dynamo called the "exciter." This machine may be permanently attached to the alternator or it may be merely belted to the shaft supplying both with power. Its entire function is to supply current to the field magnets of the alternator, which current, it must be distinctly understood, is not always obtained in this manner. It is sometimes obtained from an auxiliary or independent winding on the alternator armature which is connected to a commutator and thus makes the alternator self-exciting. The general plan, however, is to keep the exciter separate in the manner described. An alternator generally consists of four or more poles or magnets. A few figures are given in the following table showing how the reversals of current are due to the number of poles and the speed:

Revolutions per second.	Pairs of poles.	Complete reversals of current per second.
10	1	10
15	1	15
20	1	20
25	1	25
30	1	30
10	2	20
15	2	30
20	2	40
25	2	50
30	2	60
10	4	40
15	4	60
20	4	80
25	4	100
30	4	120

The idea represented here is as follows: A conductor moving past a north pole develops a current opposite in direction to that developed when moving past a south pole. A complete cycle only occurs when the wire sweeps past a north and south pole in succession. In this case the wire generates an EMF. which rises from zero to its full value, and drops again to nothing just the instant before it passes under the opposite pole. When passing under the opposite pole the process is repeated in a reversed direction and when completed the wire is about to enter upon the same cycle again. This is therefore called a complete reversal of current and is due to a conductor passing *one pair of poles*. If it passes a pair of poles 10, 15, 20, 25 or 30 times a second, just so many times will a complete reversal of EMF. be generated. Multiplying the revolutions per second by the number of pairs of poles will give the reversals, or as it is generally called the "frequency" of the current.

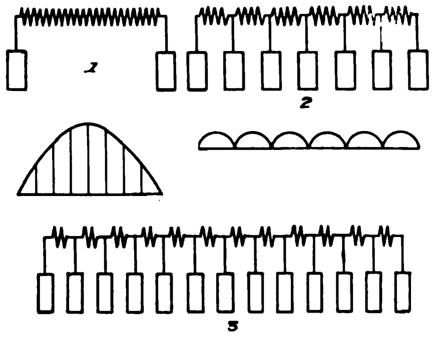
A Wave of EMF.—The function of the commutator and its relation to the impulses of EMF. generated in the armature can be best understood by a better acquaintanceship with what is called "a wave of EMF.." If any dynamo, whether it be a bipolar or multipolar, every conductor passing the poles has an EMF. generated in it which is in strict proportion to the lines of force it cuts.

If the EMF. of a conductor passing in front of a north pole is estimated in a series of positions, the product of the number of lines of force by the speed of the conductor will give the amount of EMF. developed. Suppose the EMF. is measured while the conductor is rapidly



1—Positions of the conductor. 2—Curve of EMF. corresponding to the positions of the conductor.

passing through these positions, then, at each point, the EMF. will differ, provided the rate of motion is uniform, because the lines of force are so distributed that in their case at least no uniformity exists. If use is made of such data as can be obtained in this manner, to graphically represent the entire process; then, by letting the length of vertical lines be a measure of the EMF. developed at that instant, and a base line be proportioned to the time during which these various electromotive forces are produced, a curve can be drawn through the extremities of the vertical lines which will adequately picture the rise, full growth, and fall of the EMF. As the wire moves on to pass beneath a south pole, the generating process is repeated and the result in consequence is a wave of EMF. in one direction under a north pole and a wave of EMF. in the opposite direction under a south pole. The more abruptly these waves are produced and the greater the EMF. they represent the more difficult it is to obtain what is commonly called a continuous current. If heavy impulses, due to a great many turns acting co-operatively, are rectified by means of a commutator, which would, under the circumstances, consist of comparatively few segments, then such a current would represent a series of direct pulsations. The current is direct but not, in the strict sense of the word, continuous. It is like the stream which issues from a powerful force pump without a pressure chamber—the stream is all directed one way, but occurs in increasing and diminishing spurts. If, on the other hand, the armature conductors are so arranged that only a few are connected to each commutator segment, then there would be many commutator segments required. The result of this principle would be that the abruptness and magnitude of the EMF. of a few conductors connected together would bring the current down to a gentle ripple approximating uniformity. It would still pulsate, but with small pulsations, which is the purpose of designers in laying out continuous current machines for incandescent lighting.



1—Heavy impulses with two segments. 2—Small impulses with seven segments. 3—Very small impulses with thirteen segments.

Connecting Coils to a Commutator.—Carrying out these ideas in practice in connecting coils to a commutator it is needless to state that if an armature core was wound with 1,000 turns of wire, by means of which, when revolving at 1,000 revolutions per minute in a magnetic field, 100 volts were generated, that a commutator consisting of only two segments would cause destructive sparking. It is only reasonable to believe that if the commutator segments were increased to 4, 6, 12, or in fact to something like 50, and the 1,000 conductors were divided up between them that the sparking would be very much reduced. In other words, the commutator segments, and the volts produced by the armature conductors, must be proportioned with regard to two things: first, the uniformity of the current; second, the sparking at the dynamo brushes.

Heavy pulsating currents are employed for high tension arc lighting. Direct currents of a uniform character are employed for low tension incandescent lighting. In the illustration the change of the curve from a heavy impulse to a ripple-like flow is shown through the use of a greater number of commutator segments. Carrying out this idea to its practical limitations would give a current so uniform in character that it would compare with the discharge from a storage battery through a fixed resistance.

HIGH-TENSION SWITCHGEAR.*

BY L. ANDREWS, M.I.E.E.

One or two serious accidents with high-tension switchgear of compact design have made engineers realize that, efficient and convenient though such switchgear has shown itself to be under normal conditions, the margin of reliability must be further increased in view of the paramount importance of preventing interruptions in the supply of current.

The most revolutionary departure from former practice, to be found in nearly every switchboard that has been erected during the past year, is the dividing of the controlling system up into a number of entirely separate units, each section being so isolated from adjacent sections as to render a spread of fire from one unit to another practically impossible. This entails the operation of switches placed at a distance from a central operating panel or keyboard.

American practice has tended towards the almost universal adoption of electrical control, while on the Continent the tendency has been to favor mechanical control. An excellent example of this is the switchgear controlling the 13,000-volt generators, etc., at Paderno, which has now been in successful operation for about seven years.

One argument that is sometimes used in favor of electrical control is that a large mechanically-operated three-phase switch cannot be closed sufficiently quickly for synchronizing. This argument certainly does not apply to 1,000 kw. generators or under.

Again, we are told that mechanically-operated switches must be tripped electrically, and might as well be operated electrically entirely. But merely to trip a switch that is closed by hand is a very simple problem compared to that of constructing a switch to be opened and closed electrically.

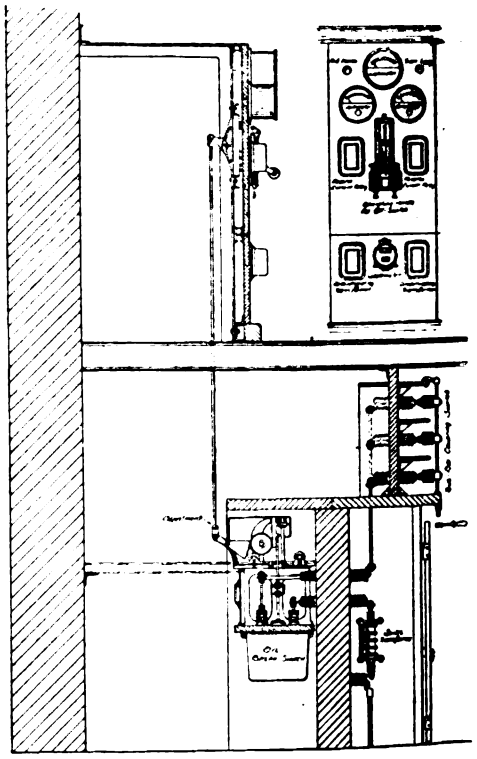


FIG. 1.

Another advantage claimed for electrical control is that it enables the high tension switches to be placed directly opposite the generators they control, as the operating keyboard can be compactly arranged in a very small space, but even this is a doubtful advantage. It seems much better practice to bring the main cables from the generators to one point of the building, at which center all the high tension switches are placed.

Electrical operation is certainly more satisfactory for controlling switches placed a long distance from the operating board.

So far we have considered the question of mechanical versus electrical control in the abstract only. A brief description of the 6,000-volt mechanically-operated boards, now in course of erection at Poplar, will show how the problem has been dealt with in this case.

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*Abstract of paper read at the meeting of the Manchester Section of the British Institution of Electrical Engineers, December 13, 1904.

Fig. 1 is a sectional view of the high-tension board in the main generating station. The construction and arrangement of the high-tension boards in the sub-stations is precisely similar.

The three-phase high-tension oil break circuit-breakers are fixed in brickwork cells on the ground floor. Each unit or section is by this means efficiently isolated from adjacent sections, and a spread of fire from one section to another is rendered practically impossible.

As this confining in narrow brick cells is apt to make some of the back connections inaccessible (and the importance of accessibility cannot be over-rated) provision has been made for withdrawing each circuit-breaker from its cell for overhauling, cleaning and inspection. For this purpose the circuit-breaker is mounted on rollers which rest on brackets fixed to the partition walls of the cells. Extension rails are provided, along which the circuit-breakers may be withdrawn.

The connections at the back of the circuit-breaker cells, together with the series transformers from which current for the instruments and relays, etc., is obtained, are also inclosed in brick cells.

No high tension cables are carried into the circuit-breaker cells, the necessary connections being made by copper rods carried through insulators set in the wall.

A detail to which considerable attention was paid in designing this board is the arrangement of the bus-bars. Each bus-bar is isolated from adjacent bus-bars by horizontal slate slabs, and to guard against any risk of an arc being formed that might destroy this slab, and so short-circuit the bars, precautions have been taken that effectually obviate any possibility of the circuit being opened in either of the bus-bar compartments.

Isolating plugs are provided to enable any circuit-breaker to be completely disconnected from the bus-bars, before working upon it. These plugs should, of course, not be removed when carrying current. In the event, however, of an attendant withdrawing a wrong plug by mistake the circuit will not be broken in the bus-bar compartment, but on the other side of a thick stone slab. As the back contact plugs are again isolated from the contacts of other phases (in this case by vertical slate slabs), the damage is bound to be confined to that particular contact. As a further precaution, the plugs are so constructed that they cannot be withdrawn more than 2 inches from the back contacts, so that should an arc be started it will not be a long and destructive one, and the attendant will thus be able to replace the plug and open the main circuit-breaker before much damage is done.

Another question, upon which opinions differ at present, is that of the necessity of separating the contacts of one phase from those of opposite phases in the main circuit-breakers. Some engineers consider that if the circuit is broken under oil the contacts of all phases may be contained in one vessel. Others go to the opposite extreme, and divide each phase from adjacent phases by brick walls.

It appears, however, that all that is actually required is that the contacts of the different phases should be contained in separate oil tanks, the latter being insulated from the high tension connections and from earth.

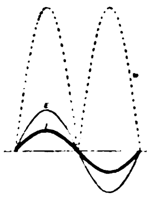
FIG. 2.

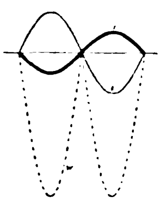
FIG. 3.

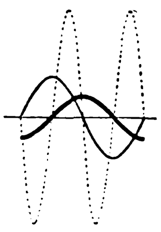
FIG. 4.

It is no longer necessary to draw attention to the fact that neither fuses nor excess-current circuit-breakers should be used between generators and the main bus-bars, but that reverse-current circuit-breakers should be used in this position. Nearly every switchboard that has been erected during the past year has been so equipped. The only danger now is that alternating current discriminating devices will be brought into disrepute, through being misunderstood. Experience has shown that some of these devices are capable of behaving in a most unexpected manner under the abnormal conditions that are liable to arise when a serious breakdown on any part of the system occurs.

As long as a generator is supplying current to feed a non-inductive load, the phase relations between current and EMF. will be as indicated respectively by the curves I and E, Fig. 2, and by compounding these curves we obtain the curve W, representing the torque or pull due to these combined forces. This pull may obviously be used to hold the cut-out in its closed position. If, now, one of a number of generators working in parallel should fail—due, say, to a bearing seizing—current will flow into this generator, tending to drive it as a motor, and this current will be approximately 180 degs. out of phase with the bus-bar EMF. That is to say, the phase relations will now be as shown in Fig. 3. We see that the direction of the pull is now reversed, and it may therefore be used to release the cut-out.

Let us now suppose that a generator, protected by cut-outs constructed as above, loses its field; current will again feed back into it from the bus-bars and other generators, but this current will not be 180 degs. out of phase with the bus-bar EMF., because its energy is not in this case expended in driving the faulty generator as a motor. The speed of this generator is being maintained by its engine. It is evident, therefore, that the reverse current must, under these conditions, be practically wattless. The phase conditions may now be represented by the curves shown in Fig. 4. It will be seen that the current curve is approximately 90 degs. in advance of the EMF. curve, and the pull or torque is alternately positive and negative, and being just equal and opposite, their combined effect is nil for any current.

A device designed to deal with a reverse current, due to a failing prime mover, is thus useless for isolating a generator having an open circuited field.

By adjusting an inductive resistance in series with the shunt circuit until the shunt current lags about 45 degs. when the series current is feeding a non-inductive load, the phase relations in the cut-out device are altered to those shown by the respective curves in Fig. 5, A representing the conditions when the generator controller is feeding a non-inductive load, B when the prime mover fails, and C when the generating field is open circuited.

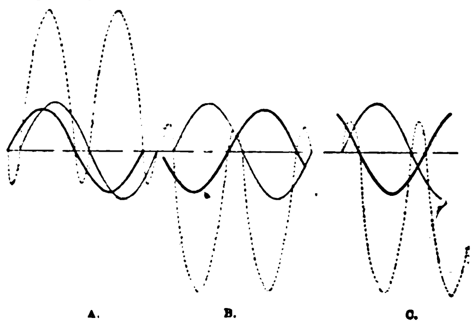
A. B. C.

FIG. 5.

(*To be continued.*)

Everett-Moore Trustees to be Released.

The affairs of the Everett-Moore Syndicate have been practically closed up and in a few days the trustees will be released. It was just three years ago that announcement was made that the street railway syndicate was in trouble. Its liabilities exceeded $17,000,000. The debts, it is said, have all been liquidated.

Proceedings of the Northwestern Electrical Association Convention.

Nearly 100 members were in attendance at the 13th annual convention of the Northwestern Electrical Association, held at the Hotel Pfister, Milwaukee, Wis., January 18, 19 and 20.

The convention was called to order on Wednesday morning at 11:45 by President T. F. Grover.

The calling of the roll was dispensed with, and the minutes of the last meeting, having been printed in book form, were accepted and approved.

THE PRESIDENT'S ADDRESS.

President Grover, in his address, stated that it was the 12th annual convention of the Association that he had attended and that he had profited and enjoyed each and every meeting. Among other things President Grover said:

"The past year, I believe, has been a successful one to the great majority of the central stations as well as to the street and interurban railway interests. Electricity is constantly reaching out and finding new industries to conquer. At the semi-annual convention of this Association held at St. Paul in 1894, as I remember, the attendants wore a badge on which was inscribed, 'The man who says electricity is in its infancy shall be hung by his neck until dead, dead, dead.' Very few of us at that time, however (although but 10 years ago) realized the steady advance that has been made in electrical industries.

"The last year will go down in history as an eventful one in electrical industries, one of the more important achievements being the opening of the New York Subway, which would not have been possible without the aid of electricity. The perfecting of the single-phase railway motor has done much for the interurban railway, as it permits the transmission of electrical energy for greater distances, and by the use of transformers does away with expensive sub-stations and opens the way for the speedy conversion of steam railways to electric.

"But little has been heard of 'municipal ownership' in the territory covered by this Association during the past year. Municipal plants now in operation have failed to show the large profits predicted, and it is easily to be seen by all fair-minded business men that a corporation properly managed operating commercial lighting, power and railway plants, can, and does furnish better and cheaper street lighting than can be furnished independently by any political body."

The President—The next order of business will be the Secretary-Treasurer's report.

The report was submitted by Mr. Mercein who reviewed the St. Louis meeting and also stated that 22 applications for membership had been received during the year.

A recess was then taken until 1:30 P.M.

WEDNESDAY AFTERNOON SESSION.

The convention was called to order at 2 o'clock.

The President appointed as nominating committee J. H. Harding, O. M. Rau and R. N. Kimball.

Membership Committee—S. B. Livermore, P. H. Korst and W. B. Jackson.

The report of the legislative committee was then presented by the chairman, Mr. S. B. Livermore, as follows:

"So far as the sub-committees have reported there has been nothing of much moment to the electrical business enacted or proposed since our last meeting.

"The committee from Iowa reports an act covering malicious mischief and trespass, which I append here to be read in full.

"The committee from Illinois reports no bills detrimental to electrical interests.

"The committee from Indiana reports a bill for an act concerning municipal corporations pending before the State Legislature of Indiana, and expects to have a copy of same to read to convention.

"The committee from Michigan does not reply to my request for a report.

"The committee from Wisconsin also makes no report although ample time has been given it to reply to my request for a report. In relation to Wisconsin, I append the heading of Governor La Follette's new bill on taxation of electric and gas properties, street railways and life insurance companies, which bill the Wisconsin members can procure from their representatives for reading.

"The committee from Minnesota reports no meeting of Legislature last winter, and so far as can be learned nothing important has been introduced this term.

"This covers the States except Michigan, and there has been almost nothing done to change the existing laws governing our business."

A paper by Mr. W. B. Jackson of Madison, Wis., was then read on the subject of the "Successful Joint Utilization of Several Small Water Powers by the Janesville Electric Company."

Mr. Jackson's paper was received with great applause.

Mr. Korst—There has been an important omission made in the paper just read, and that is, that Mr. Jackson has been our consulting engineer and designing superintendent of our new plant and I think it is proper that the members should know that.

Motion made, seconded and unanimously carried thanking Mr. Jackson for his paper.

Mr. Almert—While they are distributing Mr. Rau's paper, I would like to suggest that Mr. Jackson furnish, to be published in the proceedings, a diagram showing the arrangement of these different units, different clutches, etc.

The President—You wish Mr. Jackson to give some diagrams showing the connection of clutches, switches, etc., in the Janesville plant?

The Secretary—You mean add that to his paper, or print them with the proceedings?

Mr. Almert—Yes, he has blue prints in his office showing that, and I think it would be very valuable to some of us.

The President.—With Mr. Jackson's approval that will be done.

Mr. O. M. Rau of Milwaukee then read a paper on the subject of "A. C. and D. C. Distribution."

Before reading his paper Mr. Rau said: "I have been engaged in an extensive investigation as to the relative advantages of A. C. and D. C. distribution, and an account of that investigation forms the subject of my paper."

A long discussion followed the reading of the paper.

The secretary then read a paper on the subject of "The Rating of Arc Lamps," written by Prof. George D. Shepardson, of Minnesota University.

The President then introduced Mr. James Wood Pogue, manager of the Milwaukee branch of the Sheldon School of Salesmanship, who delivered a long address, which he concluded by relating the following little story illustrating what is meant by the power of salesmanship: "It is an exceedingly simple story in a way, and yet it is one which contains a thought that everyone of us can profit by, particularly as it comes from a lady. Two ladies, one named Mary and the other Elizabeth, were born on the self-same street about the self-same time. They grew up as girls together, went to school together, and one being wealthier than the other, was sent to college. They were in social life together, but drifted apart. Finally one day they met after years, and

Mary said to Elizabeth, 'I see you are about to be married again,' and she said 'Yes, I believe that is true,' and Mary said: 'Elizabeth, I can't understand it. You and I were born about the same year, we grew up together, we lived together, were friends together, but I went off to college and you could not go. I have more money than you have, and I believe I am as good looking as you are, and yet you have had two husbands and are about to get a third, and I cannot get one at all. Will you explain the reason?' And Elizabeth thought a while, looked her friend kindly in the face, and with a smile said: 'Mary, I will tell you, it is not just being born, and it is not just living on the same street, and it is not just going to college, nor having money, nor beauty, but the secret of it, Mary, is this, it is the come hither in your eye that makes the difference.' And that is what it is in the business world. I thank you for your attention." (Applause.)

The convention then adjourned until 9:45 A.M. next day.

Thursday Morning's Session.

The meeting was called to order at 10:25 by the President, who announced the first order of business would be the discussion of the paper of Mr. Williams on "Distribution and Dollars."

Nearly all the members joined in the discussion.

The President—We will listen to the paper by Mr. E. P. Warner, of Chicago, on the subject of "Series Alternating Arc Lamps."

After his paper had been read Mr. Warner said: "I will say in this connection that there are quite a variety of completely disconnecting switches on the market, all of which are said to be safe devices, and I have no doubt that in many cases people have made use of them to handle lamps and trusted their lives to these devices, thinking they did completely isolate the lamp from the circuit, but I have yet to see a device that I would advise managers to use and permit their employes to stand on the ground and handle a lamp even when the switch was operated."

The President—I would suggest that the matter of the discussion of this paper be laid over till this afternoon and that the nominating committee make its report before we go into executive session.

Mr. Harding—The nominating committee begs leave to submit the following names for the officers and directors for the next year:

President—C. H. Williams, Madison, Wis.

First Vice-President—Roger N. Kimball, Kenosha, Wis.

Second Vice-President—H. Almert, Oak Park, Ill.

Secretary and Treasurer—Thomas R. Mercein, Milwaukee, Wis.

Directors—P. H. Korst, Janesville, Wis.; Ernest Genzenbach, Sheboygan, Wis., and H. J. Gille, St. Paul, Minn.

Mr. Livermore—I move that the report of the nominating committee be received and filed and the Secretary instructed to cast the ballot of the Association for the election of the nominees.

Motion seconded, unanimously carried and so done.

Secretary Mercein—I simply think it due to state this, that I have served for years under a number of presidents, and have found none more helpful and none who have taken more interest or given more efficient aid to the secretary than the retiring president, Mr. Grover, and I move that he be given a vote of thanks for his active and efficient service during the past year.

Motion seconded and unanimously carried amid great applause.

President Grover—I thank you, gentlemen. Mr. Lord, will you please escort the President-elect to the chair?

Mr. Lord—(escorting President-elect Williams to the chair). I take great pleasure in presenting to you Mr. C. H. Williams, your new President. (Applause).

Mr. Williams—I thank you sincerely for the honor you have conferred on me in making me your executive officer. I feel that you have placed a great responsibility upon somewhat inexperienced shoulders, but with your help I will try to make up in activity what I lack in experience. (Applause.)

The Association then went into executive session and shortly after adjourned until afternoon.

Thursday Afternoon's Session.

At 2 o'clock the convention was called to order by the President.

The President—We have a long programme to get out this afternoon, and the next paper is by Mr. W. T. Goddard, on "High Tension Practice."

This was a lecture consisting largely of lantern slides (described by the speaker).

A paper by Mr. Clarence Renshaw, of Pittsburg, was then read on "Single Phase Railways and Their Possibilities." This paper was also illustrated by stereopticon slides.

The President—We will now listen to Mr. McCarthy's paper on the "Economy and Working of the Diesel Engine."

Mr. J. W. Shuster, of the University of Wisconsin then read a paper on the subject of "Motors."

Adjourned to 10 o'clock A.M. next day.

Friday's Session.

The convention was called to order by the President, and there being no further business an adjournment was taken sine die.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JAN. 17, 1905.

Electric Railways and Appliances.

780,120. Electric-Railway Signal. Elwood W. McGuire, Richmond, Ind. Filed Feb. 6, 1904.

780,194. Sheath for Trolley-Wheels. Santos Jurado, New York City, assignor, by mesne assignments, to William Fechtenburg & Co., same place. Filed March 25, 1904.

780,316. Third-Rail Insulator. Paul Winsor, Weston, Mass. Filed June 10, 1904.

780,386. Electromagnetic Traction Device. George W. Thompson, Melrose, Mass. Filed July 26, 1904.

780,388. Trolley. Gutie H. Tuttle, Shorter, Ala. Filed Oct. 26, 1904.

Electric Lights and Appliances.

780,065. Electric Lamp. Elijah R. Roberts, Bellevue Pa., assignor to George Westinghouse, Pittsburg, Pa. Filed Dec. 15, 1900.

780,087. Incandescent-Electric-Light Bulb. Martin C. Burt, Chicago, Ill., Filed March 4, 1904.

780,222. Electric-Lighting System. Granville E. Palmer, Boston, Mass. Filed June 1, 1903.

Electrical Machinery and Apparatus

780,024. Circuit Making and Breaking Relay. Frank Conrad, Edgewood Park, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Dec. 29, 1902.

780,045. Single-Phase Alternating-Current Motor. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed May 3, 1904.

780,046. Armature-Winding for Electric Motors. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed May 3, 1904.

780,047. Electric Motor. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed June 30, 1904.

780,048. Single-Phase Alternating-Current System of Distribution. Paul M. Lincoln, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed May 3, 1904.

780,055. Electrical Controlling Apparatus. Frank C. Newell, Wilkinsburg, Pa., assignor to the Westinghouse Air Brake Company. Filed May 5, 1902.

780,058. Controller for Electric Motors. Thomas S. Perkins, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed June 24, 1902.

780,104. Electric Controlling Apparatus. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Elevator Company. Filed July 31, 1903.

780,221. Electric Igniter. James W. Packard, Warren, O., assignor to the Packard Motor Car Company, Detroit, Mich. Filed Jan. 10, 1903.

780,275. Current-Motor. George D. Foster, Preston, Ia. Filed Nov. 30, 1903.

Telephones and Telephone Apparatus.

780,093. Telphone System. Alfred Ekstrom, Stockholm, Sweden, assignor to the Aktiebolaget L. M. Ericsson & Co., Stockholm, Sweden. Filed Dec. 17, 1902.

780,439. Electric-Circuit Closer. John K. Norstrom and Henry M. Graif, Chicago, Ill., assignors to the Automatic Telephone Company, same place. Filed June 18, 1903.

Miscellaneous.

780,191. Electrochemical Separation of Metals. Woolsey M. Johnson, Hartford, Conn. Filed June 23, 1902.

780,228. Electric Stove. Earl H Richardson, Ontario, Cal., assignor, by direct and mesne assignments, to the Pacific Electric Heating Company, same place. Filed Jan. 25, 1904.

780,322. Electric-Dental Instrument Holder. Monroe N. Callender, San Francisco, Cal., assignor to J. W Rooch, same place. Filed Nov. 3, 1904.

780,365. Storage Battery. Joseph Melzer, Cleveland, O., assignor to the Osborn-Morgan Company, same place. Filed April 2, 1904.

THE TELEPHONE WORLD.

Telephone Rates to be Incr

Although the official announcement has not been made, it is understood that telephone rates in Cortland, N. Y., will be increased on or about July 1.

The Cortland Home Telephone Company has made large expenditures of late in erecting a new building and installing a new switchboard. The higher rates are necessary to keep the service at the top level of efficiency.

The proposed changes in rates follow: Business 'phones will be advanced from $24 to $36 a year; residence 'phones from $12 to $18; two person lines will be raised from $12 to $15 a year.

The work of fitting up the new building is progressing rapidly, and it is expected that it will be ready for occupancy by the latter part of February.

Mexican Telephone Systems.

The work of constructing a telephone line between San Luis Potosi and San Felipe, Mexico, has been completed. The Mexican Government has declared forfeited the concession which was held by J. Woesner, of Saltillo, for the construction and operation of a system of long-distance telephone lines in Northern Mexico. It is stated that Mr. Woesner was unable to comply with the terms of the concession. A part of the system was constructed and is in operation.

The executive committee of the Ohio Independent Telephone Company met in Columbus recently to perfect arrangements for a definite understanding among the several Independent interests regarding the measure to be adopted to meet the competition of the opposing company. Among those present was J. C. Reber, of the Home Telephone Company of Dayton.

The Rural Telephone Company of Port Byron, N. Y., and vicinity, was recently organized with officers as follows: President, C. W. Weston; vice-president, F. S. Root; secretary and treasurer, H. R. Warren; board of directors: H. R. Warren, F. A. Mead, Addison Cole, John Monroe, T. M. Crane, F. S. Root, all of Port Byron, and Dr. Sawyer, of Montezuma. It is capitalized at $50,000, each share being $50.

A movement is said to be on foot in Johnstown, N. Y., to organize a new telephone company in opposition to the Glen Telephone Company, which recently increased rates. It is said that a number of capitalists of that place have been interviewed with regard to the matter by a representative of an Albany Independent company, and that he has been given considerable encouragement.

When the telephone company in Ogdensburg, N. Y., gets established in its new exchange office it will begin installing free trial 'phones throughout that city.

The Delaware & Atlantic Telegraph and Telephone Company of Camden, N. J., has amended its certificate, showing a capital of $397,945 fully paid in.

The Marne & Elkhorn, Ia., Telephone Company has increased its capital to $15,000.

To Cut Telephone Rates.

The Syracuse, N. Y., Telephone Company, in annual session lately, elected the following officers: President, J. J. Jermyn; vice-presidents, H. W. Plumb and Arthur R. Peck; treasurer, R. G. Jermyn; general manager, F. M. Potter, Jr. These officers together with J. L: Wentz, H. A. Moyer and A. A. Howlett comprise the board of directors. The company is planning to place into effect a rate of $10 annually for telephone service, and a cent a message above the $10. This is looked upon as a move to reduce the rates. The present rates are as follows; Private lines, business, per month, $3; residence, $2; party line, business, $2.50, and residence, $1,50. The company was authorized to increase the bond issue from $300,000 to $1,000 000 and the proceeds from the sale of bonds will be used in the construction of a new plant. The site for the building has not been decided upon.

Gives Some Telephone Facts.

Interesting facts in the development of the telephone system were contained in the lecture recently delivered to the Franklin Institute by C. J. H. Woodbury, assistant engineer of the American Telephone & Telegraph Company. These were some of the things he emphasized;

"The telephone service now knits together in one system more than 26,000 settlements throughout this country.

"Time for telephonic transmission over 1,064 miles between Boston and Chicago is .006 of a second, while the distance the voice is transmitted through the air in that time is 6⅓ feet.

"In the Bell telephone system there are approximately 6,300,000 poles, and about 1,000,000 are required yearly for replacement and for extension of lines"

At the annual meeting of the stockholders of the Union Electric Telephone & Telegraph Company to be held next month a proposition to furnish a toll service with cities throughout Illinois having Independent lines will be acted on. All Independent lines in the State it seems are endeavoring to get together on some basis by which messages can be interchanged over the various lines.

At the annual meeting of the Upper Lisle, N.Y., Telephone Company the following officers were elected: President, Frank Brannan; secretary, Arthur Rooks; treasurer, Martin Sherwood; directors, John Stalker and George A. Landers.

A new telephone system is to be installed in Tiverton, R. I., soon by the Strowger Automatic Company. Automatic 'phones of an improved style are to be put into Little Compton, Tiverton, Four Corners and Tiverton proper.

A. B. Crawford, formerly of Elgin, Ill., has purchased a private telephone line at Nunda in that State which he will install as soon as possible.

The Farmers' Telephone Company of Hopedale, Ill., has increased its capital stock from $5,000 to $20,000.

There is prospect of an extension of the telephone service in the rural parts of Dudley, Mass.

Census Report on Telephone and Telegraph Systems.

The Bureau of the Census has recently published the fourth of a series of reports on the generation and utilization of electric current during the year ending December 31, 1902. The present bulletin concerns telephones and telegraphs.

Although the commercial telephone has developed entirely during the past 30 years, the bulletin states that it is now of vastly greater importance than the telegraph. The extension of the long distance service, the introduction of the commercial systems into rural districts, the establishment of Independent rural lines, the development of such lines, in some instances, into mutual systems with an exchange and more extensive service, and the rapidly increasing use of the telephone in private dwellings, all point to a growth of the industry that can hardly be realized. In 1902 the wire mileage operated by commercial and mutual telephone systems together constituted 70.6 per cent. of the combined mileage for such systems and commercial telegraph systems, and these same telephone systems gave employment to 70.7 per cent. of the combined wage-earners, paid 65.5 per cent. of the wages, received 68 per cent. of the revenue, and paid 67.8 per cent. of the expenses.

At the census of 1880 the telephone industry was in embryo, few commercial companies being in operation prior to that year. The financial interests represented were relatively of great importance, but the amounts were comparatively insignificant as compared with the totals for 1902.

The number of miles of wire in use in 1902 was 141 times, and the number of telephones nearly 43 times as great as in 1880. The number of miles of wire, and the number of instruments operated in 1902 by the Independent rural lines, which in 1880 were not in existence, were in excess of the totals for the entire industry in the earlier year.

In 1880 the population of the United States was 50,155,783, and the number of telephones of all kinds was 54,319, giving an average of 923 persons per telephone; the population of continental United States in 1902 is estimated at 78,576,436, and the number of telephones operated in that year was 2,315,297, giving an average of 34 persons per telephone.

The commercial systems in 1902 numbered 3,107—three times as many as the mutual systems, of which there were 994.

Telephone Incorporations.

The Rose Telephone Company, New York City. Capital stock, $15,000. Incorporators: H. K. Rose, Mary J. Rose, South Kortright; C. E. Hanford, Hobart.

The Guarantee Telephone & Equipment Company, Chicago, Ill.—to manufacture telephones and electrical supplies. Capital stock, $2,500. Incorporators: L. Anderson, Albert Dace and Donald E. Turner.

The Bremen Telephone Company, Bremen, O. Capital stock, $5,000. Incorporators: H. M. Shelhamer, S. E. Shull, J. C. Shaw, G. E. Turner, M. E. Osborne, L. E. Sherlock and J. S. Brown.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Bayonne, N. J.—The project of Mayor Brady, to have this city erect and operate its own electric plant for lighting the streets, was recently indorsed by the board of trade.

Bay City, Mich.—The board of electrical control is considering bids for the erection of the new commercial lighting plant.

Becker, Minn.—This city is to have an electric light plant.

Bridgeville, Pa.—This town will soon have its streets lighted by electricity.

Burlington, Ia.—Plans are on foot to organize a stock company for the purpose of putting in an electric light plant.

Canastota, N. Y.—It is quite probable that the citizens will vote on the proposition of installing an electric light plant.

Cayuga, Ind.—The town board is considering the establishment of an electric light plant.

Chicago, Ill.—Plans are being prepared by Sargent & Lundy, Exchange Building, this city, for a large electric lighting plant at Waukegan, for the North Shore Electric Company.

Columbus, O.—The board of managers of the penitentiary have decided to install electricity for lighting purposes.

Covington, Ga.—This city has under consideration the re-establishment of its electric light plant, recently destroyed by an explosion entailing a loss of $12,000. Address J. F. Henderson.

Creston, Ia.—W. H. Schott is preparing plans for a gas, electric light and heating plant.

East Moline, Ill.—It is reported that P. C. Dunbar is interested in the construction of an electric lighting plant here.

Florence, Col.—The Arkansas Valley Electric Light Company contemplates enlarging its plant.

Forrest City, Ark.—Eugene Williams, cashier of the Bank of Forrest City, has purchased the electric light plant from Captain Head, for $10,000.

Fort Valley, Ga.—The citizens will vote about March 1, to consider the question of establishing a municipal electric lighting plant. J. L. Fincher, mayor.

Fort Worth, Tex.—George Armstrong has purchased a site on which he will build an electric lighting plant.

Gifford, Ill.—An electric light company has been organized here by Dr. T. J. McKinney, J. D. Morse and others, and an electric light plant will soon be erected.

Homer, La.—This town has under consideration the establishment of an electric light plant.

Jacksonville, Ore.—A franchise has been granted to the Condor Water & Power Company to furnish electric lights for this city.

Jefferson City, Tenn.—A movement is being made by the Jefferson City Electric Light Company to replace the plant burned a short time ago.

Knoxville, Tenn.—The city council has passed a resolution favoring the municipal ownership of the city electric light plant.

Lamoille, Ill.—An electric lighting plant will be installed here.

Middlebourne, W. Va.—J. W. Jackson contemplates the establishment of an electric light plant.

New Albany, Miss.—This town will hold a special election January 31, to pass on the question of issuing $20,000 bonds for the construction of waterworks and electric light plants.

Northville, Mich.—The common council has granted a 30-year franchise to C. A. Ward, of Ann Arbor, for furnishing electricity for lighting the streets, and power for factories in this city.

Oshkosh, Wis.—The Duran Light & Power Company's plant of this city has been destroyed by fire. The loss is said to be $16,000.

Paris, Ill.—The capital stock of the City Gas & Electric Company has been increased to $60,000, and will be expended in improving the plant.

Pittsfield, Ill.—The Pittsfield Electric Light Company contemplates erecting a new power house with more machinery, to be located near the Wabash tracks.

Russellville, Ark.—A. Bemard, S. J. Smallwood R. L. Harkey and others have incorporated the Merchants' Light & Cold Storage Company of this city with a capital of $50,000. It is proposed to operate an electric light, power, storage plant, etc.

San Antonio, Tex.—It is reported that C. A. Ziker, vice-president of the Southern Ice & Cold Storage Company contemplates organizing a company to establish an electric light plant.

St. Louis, Mo.—The board of public improvements has appropriated $15,000 for an electric lighting plant at the City Insane Asylum.

Sturgeon, Mo.—The installation of an electric light plant is proposed in this city. J. W. Hulett, O. D. Gray and P. I. King have been appointed as a committee.

Yoe, Pa.—The Yoe Electric Light Company, with a capital of $5,000, has been incorporated

STREET RAILWAYS.

Bowling Green, O.—The Toledo & Bowling Green Traction Company, with a capital of $1,000,000, will erect a new consolidated power house at a cost of $200,000.

Clinton, Ind.—There is considerable discussion here of a proposed interurban line between this town and Paris, which it is thought will result in something tangible.

Delta, Col.—The board of county commissioners has granted an electric road franchise to W. B Stockham and Charles Pike.

Leola, S. D.—Farmers living in this vicinity have taken up the project of building an electric line between here and Aberdeen.

Lexington, Ky.—The Fayette Traction Company will build a railway from this city to Versailles.

Litchfield, Ill.—W. B. McKinley will erect a trolley line from here to Decatur.

New Haven, Conn.—The New York, New Haven & Hartford Railroad last week took over another trolley line, the Berkshire Street Railway, which runs from Great Barrington, Mass., to Cheshire, about 30 miles. It paid about $800,000 for the road. The bonds bear 3 per cent. for the first few years of their running and 3¾ afterward.

Rolfe, Ia.—The matter of the building of an electric road from here to Fonda is being considered.

Shelbyville, Tenn.—An electric line will be built between this city and Fayetteville.

Springfield, Ill.—The stockholders of the Springfield & Northeastern Interurban Company have voted to issue bonds to the amount of $700,000, for the construction of a power house for the line between this city and Bloomington. The power house will be built at Lincoln.

St. Charles, Mo.—Another new electric line is to be erected here.

Vinton, Ia.—A franchise has been granted to the Vinton & Belle Plaine Electric Interurban Railway Company.

Winona, Ind.—The Winona Interurban Railroad Company will erect a new power house at a cost of $600,000, to furnish power for the various electric lines it proposes building.

POWER PLANTS.

Allegan, Mich.—The Kalamazoo Valley Electric Company, which owns three large power houses on the Kalamazoo River, located at Otsego, Plainwell and this place, contemplates the expenditure of a large amount of money for the purpose of putting in more power plants in various parts of Western Michigan.

Birmingham, Ala.—The Tallapoosa Water Power & Electric Company is to be incorporated. Ausfeld & Chapman, contractors and engineers, are interested A plant to cost $500,000 is to be built.

Duluth, Minn.—The Great Northern Power Company, recently incorporated with a cash capital of $4,000,000, obtained through C. D. Barney & Co., and Tucker, Anthony & Co. will put up a plant near this city, on the St. Louis River, to develop 30,000 hp., to be raised eventually to 200,000. It is expected that the United States Steel Corporation will contract with it for electric motive power to run both the Duluth & Iron Range and the Duluth, Missabe & Northern.

Gering, Neb.—The construction of an $85,000 power plant on the North Platte River near here is proposed by G. L. Shumway, of Scott's Bluff.

Hamburg, Mich.—A large power plant is being built here. Ex-Senator Charles A. Ward, of Ann Arbor, is the promoter.

Pecos, N. M.—It is proposed to construct a large power plant on the Pecos River near the Pecos Forest Reserve to transmit electric power to Albuquerque, Santa Fe and Las Vegas. Joseph C. Bonner, of Toledo, O., is interested.

Sumter, S. C.—George E. Ladshaw will install a power plant here.

BIDS WANTED.

Columbus, O.—J. A. Taft, 307 New Hayden Building, is in the market for a good second hand 14 x 16 inch, or a 16 x 42 inch Corliss engine.

Johnson City, Tenn.—The Barton-Nuchols Hardware Company wants prices on electrical supplies.

Lyons, Ga.—J. B. Exum, of this place, is in the market for dynamos, engines and boilers.

Mullins, S. C.—J. B. Blackman, care of the Pee Dee Brick Company, of this city, wants to purchase a 50 hp. engine and 60 hp. boiler.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15¼@15⅜c.; casting, 14⅞@15c.

The annual meeting of the Lowell (Mass.) Electric Light Company will be held in Lowell February 1.

The Chicago Edison Company has declared the regular quarterly dividend of 2 per cent., payable February 1.

The executive committee of the Massachusetts Electric Companies has decided to issue hereafter quarterly statements of gross and net earnings.

There is no basis for the rumor that the next dividend on General Electric will place the stock on a 10 per cent. basis. The regular 2 per cent. dividend will be declared.

James F. Shaw has filed a petition in the Massachusetts Senate for the incorporation of the Boston & Providence Street Railway Company with a capital of $1,500,000.

The $10,000,000 bond issue for the purpose of constructing the proposed Cincinnati, Toledo & Columbus Traction Line, has already been subscribed and the road is now assured.

The Western Telephone & Telegraph Company has declared a semi-annual dividend of 2½ per cent. on the preferred stock, payable February 1. This is the same rate as was declared last August.

The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent. on its preferred stock, payable February 15. Books close February 4 and reopen February 28.

It is now said that the Keystone Telephone Company of Philadelphia has made no deal for the sale of its underground conduits, and that the development of the company on independent lines is to be expected.

It is reported that the Brooklyn Rapid Transit Company will issue $10,000,000 bonds in the near future, the proceeds from the sale of which will be expended on improvements during the current year.

Kuhn, Loeb & Co. of New York have purchased from the Western Union Telegraph Company $3,000,000 of its funding and real estate and mortgage bonds. This is part of an issue of $20,000,000. The bonds will bear 4½ per cent. interest.

Negotiations for an indeterminate franchise along the lines suggested by August Belmont will probably be opened by the new traction syndicate with the city of Chicago as soon as a majority of the Chicago City Company's stock has been deposited with the Illinois Trust & Savings Bank.

The stockholders of the Butte Electric & Power Company, a New Jersey Corporation, at a meeting held in Newark, voted to increase the capital stock from $2,500,000 to $3,000,000. The present capital stock is divided into $1,000,000 of preferred ond $1,500,000 of common stock. The new stock will be used in the purchase of additional plants at Butte, Mont. It is also probable that an issue of bonds will be made in addition to the stock issue for the same object.

Interborough in the course of its movements on the Curb in this city on Monday sold up to 202⅜. Later it dropped abruptly to 195¾, and the final sale was made at that price. Shortly after the opening the stock was offered as low as 194, but that was taken and no sale was made below that figure. Transactions in the stock amounted to about 7,500 shares, or less than the total for the two hours of trading on Saturday, when the price rose from 187 to 199.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Jan. 23
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	171
Metropolitan Street Railway	116⅞
Metropolitan Securities	76⅜
Ninth Avenue	197
Third Avenue	129⅞
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	60¾
Interborough Rapid Transit	188
New Orleans Railway	3½
Public Service Corporation (New Jersey)	141
Philadelphia.	
Consolidated Traction of New Jersey	83½
Philadelphia Traction	100
Union Traction	59
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	15
do. do. do. pref.	60
West End Street, com	95
do. do. do. pref.	114
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	12
do. do. pref.	47½
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	15½
do. pref.	64
Electric Boat, com	42
do. do. pref.	83
Electric Lead Reduction	½
Electric Vehicle, com	15
do. do. pref.	24
Westinghouse, com	179
do. pref.	195½
General Electric	186¾
Boston.	
Edison Electric Illuminating	252
General Electric	186
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	156
National Carbon, com	41¼
do. do. pref.	113
Philadelphia.	
Electric Company of America	10¾
Electric Storage Battery, com	78
do. do. do. pref.	78
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	144¾
Western Telephone Company	19½
New England Telephone Company	140
New York.	
American Telegraph & Cable Company	93½
Commercial Cable Company	210¼
Mexican Telephone Company	2
New York & New Jersey Telephone Company	158¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	9½¼
Chicago Telephone Company	141¼
MISCELLANEOUS STOCKS.	
Otis Elevator Company	49
Consolidated Car Heating	64
Standard Underground Cable	200

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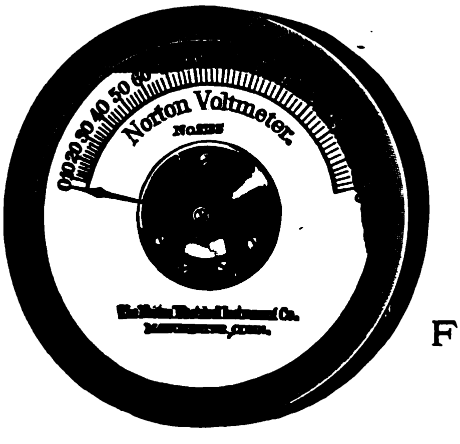
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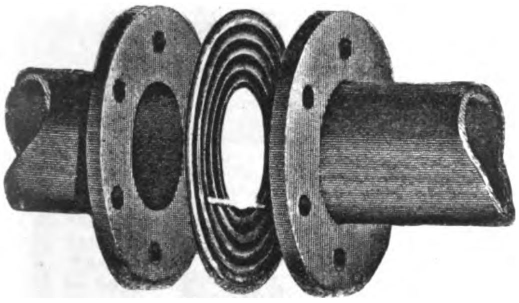

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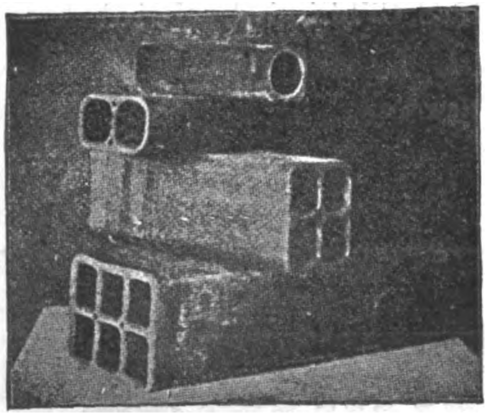

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EDITORIAL NOTES.

Wednesday's Blizzard.

The snow storm which began Tuesday night, January 24, and kept up all through Wednesday tested the transportation facilities in Greater New York as nothing else could have done.

The storm itself lasted scarcely twenty hours, but during that time 9½ inches of snow fell. To make matters worse, the thermometer stood most of the time at 10 degrees above zero and a 40-mile-an-hour wind prevailed.

With conditions such as these, the majority of the surface cars in the Borough of Manhattan were, in a very short time, unable to run, due to the slot filling with snow of the consistency of granulated sugar.

In Brooklyn, the cars being equipped with the overhead trolley, managed to keep running in a desultory sort of way.

Owing to the dryness of the snow the trains on the elevated roads were not delayed nearly as much as was to have been expected. It is true pyrotechnical displays between the third-rail and the shoes on the cars were constantly in evidence, but nevertheless the road continued to be operated and passengers were carried.

But it was the new subway that was really in demand during and just after the blizzard. Tremendous crowds poured into and out of the subway stations all along the line. Ticket men and trainmen went about without overcoats and it was hard to realize, owing to the warmth of cars and stations, that Siberian weather was being experienced a few feet overhead.

But in this emergency the subway solved the transportation problem and carried the majority of passengers, and that without delay or accident of any kind.

When the rest of the tunnels are completed, not only in Manhattan Borough but to Brooklyn and New Jersey, which is to be hoped will be soon, then Greater New York will be prepared for any kind of weather.

* * *

A Forty-Knot Cruiser.

In the issue of ELECTRICITY of April 27, 1898, we referred at considerable length to a so-called electrically-propelled cruiser which had then recently been brought out. The inventor, Mr. Richard B. Painton, claimed that by making use of ten to sixteen independent propellors a ship could be driven through the water at the rate of forty knots an hour.

In this connection it is interesting to note that a bill has just been introduced in the House of Representatives at Washington, having for its object the authorizing of the Secretary of the Navy to make a contract with Mr. Painton for not only a cruiser but a torpedo boat as well. The former would cost, approximately, $2,000,000 and the latter $500,000.

If the bill is passed and the ships built the motive power will be electricity generated by dynamos operated by steam turbines. Electric motors will be made use of exclusively.

The sum of money which it is desired to have appropriated seems a large amount to be expended more or less experimentally, but if when completed such a cruiser would accomplish what is claimed for it in the way of speed, the people's money will not have been spent uselessly.

* * *

Rapid Relief in Storm Centers Through Electricity.

The test of efficacy which must be applied to electrical apparatus is the test of serviceability under the stress of adverse conditions; conditions which for a time at least plunge or threaten to plunge a large city into a state of chaos. Recounting the advantages of a purely superficial character which arise, due to the invulnerability of electrical devices to such influences, is too light a reference to the real truth. There are certain facts worthy of presentation in connection with electrical service of any kind at the present hour which lie deeper down than the mere mention of their operativeness during storms. It is easy to realize that the greatest stability has been reached in the equipment and construction of our best known institutions of that kind. To the public, changes which are and have been taking place have merely appealed to them in a negative sense.

Poles once above the ground have disappeared; electric lights which once flickered and frequently went out now burn brightly; electric cars reach their destination with certainty, and the telephone, no longer a nerve-racking experiment, has entered the field of successful and substantial engineering accomplishments. There is something to be said of all these beside the mere fact that they work. Surely the steady throb of an engine and the hiss of a dynamo are indications of greater progress than the tympanum alone can appreciate. The substantiality of electrical devices today is the surest proof of a scientific and technical grasp of existing conditions by electrical engineers.

The readiness with which a great city like New York recovers from the grip of an arctic storm of almost unprecedented severity is in reality a triumph of engineering. How dependent the average citizen is upon the inventor can only be understood with emphasis when his devices absolutely fail. In the city all great financial transactions require the ticker and the telephone—and outside of it the telegraph holds sway. In a great bee-hive of industry like New York, the cessation of transportation facilities means the stagnation of commerce and manufacturing. The intensity of city life—its very "strenuousness"—is based upon the use of these most modern methods of travel and education.

The great arteries, through which the animating force of great cities is transmitted, are the trolley, telephone and telegraph lines. If these hold good during great meteorological changes their influence is hardly felt. What testimonial to the technical excellence of such necessities is heard of after storms and floods have passed away? Huge snow banks may impede traffic, and in addition the trolley lines unfortunately crossing their path; but this does not mean that the service has broken down.

It does not mean that the system is poor, it is no more a criticism against an electric system than if an avalanche swept away wires and conduits or a tornado destroyed the rolling stock of steam roads. The point of greatest interest is the rapid recovery of a great city from the thraldom of ice and snow. How this is accomplished and the degree of effectiveness it represents are one of the newest and most interesting propositions of city life. A well-known editor of a great daily paper once said "Take away the telegraph and telephone and what will civilization have left?" The military sages have understood this fact, and in warfare the isolation of a town or city is practically electrical isolation. When severe storms beat upon the telegraph and telephone systems ineffectually—winds of 50 and 60 miles an hour—it must excite admiration for the solidity attached to such delicate equipments. It is only by this solidity that municipal paralysis is prevented and we are able to enjoy, uninterruptedly, the comforts or luxuries which are our birthright. If a great storm brings no other lesson it at least shows to advantage the skill and knowledge of American electricians. It also proves the proposition that whatever reward an inventor may or may not get, he at least is among the greatest of public benefactors, and it is his gifts which are most valued when nature is at her worst.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The threatened strike of the employes of the Interborough Rapid Transit Company of this city has been averted. The company has granted practically all the union demands. Several discharged employes will be reinstated, motormen will be allowed 15 minutes' rest at the end of each trip and more safety signals will be placed in the subway.

The inauguration of three-cent fares on the Cleveland Street Railway has proved a failure. The three-cent cars which were plainly placarded were but poorly patronized.

The Electrochemical Society and the New York Academy of Sciences has bestowed the name moissanite on the carbon silicide in the form of six-sided crystals found in the residue from dissolving the iron meteorite from Canon Diablo, Arizona. The name was given in honor of Dr. Henri Moissan, member of the Institute of France, who has added to his many discoveries of carbides by means of the electric furnace that of the new silicide in the meteor. The newly discovered silicide is harder than any known substance, except the diamond.

On January 26, the day after the storm, the underground road in the Borough of Manhattan carried 411,000 passengers. The increase was due to the fact that few, if any, of the principal surface lines were running.

George Baker of Traverse City, Mich., has invented a water-wheel which is a combination of turbine and horizontal, using both perpendicular overshot systems. It is especially adapted to use in small streams, giving a high horse power with a low head of water. It is claimed by the inventor that farmers will be able to light buildings with electricity and secure all the needed power for stationary machinery.

Messages were lately telegraphed and telephoned simultaneously on the telegraphone between Peoria and Chicago, Ill., and the experiment was pronounced an entire success. The inventor of the device is H. C. Rugh, who holds patents in twelve different countries.

The German Emperor, according to the "Electrical Engineer," London, is exceedingly jealous about anything that concerns Potsdam, for it was there that his "never-to-be-forgotten" ancestor the great Frederick was born. Lately it has become recognized as imperative that electric traction shall supersede the old horse cars, but in the middle of the road connecting the town with the railway station are the remains of the old linden tree around which the people were wont to attend upon Frederick with petitions. This would have to be removed, and though it is but a remnant of decayed timber, the Kaiser insists that sentiment shall prevail over utility. His Majesty objects to the use of the overhead system on this road and suggests that the best plan would be to use an alternative route, which should also be well away from the palace. It is estimated that an additional expenditure of over $300,000 would be entailed, but "the Kaiser promises that the State shall bear half." As the Potsdam coffers are not overloaded, even a moiety of this sum represents a substantial tax, and a number of the inhabitants consider hero-worship rather dear at the price; but it looks as though the town will have to acquiesce—or, at any rate, pay.

DIRECT CURRENT VERSUS ALTERNATING CURRENT DISTRIBUTION.*

BY O. M. RAU.

With the recent policy of consolidation where railway and lighting properties are under the same management, the best method of distribution for the lighting system has become a question of considerable importance.

The generally adopted method of operating extensive railway systems is by means of high tension A. C. main stations and rotary converters. This makes available the prime source of power from the high tension main stations for the lighting system, which must be converted suitably for the various systems of distribution installed, which generally consists of a series alternating arc lighting system for street lighting, a 110-220 volt Edison direct current system for the thickly populated districts and a 2,300 volt alternating current transformed to 110-220 volts for the suburbs.

With this variety of distributing systems a very complicated assortment of secondary apparatus is necessary, making the original investment very high and creating a maintenance account considerably above that which would prevail if the system were more unified.

The one problem to this end, which seems most difficult to solve, has been the abandoning of the old standby Edison system. It is my opinion that the 25 cycle alternating current apparatus would never have reached the development that it has at the present state of the art had the consideration of abandoning the direct current, and displacing it with alternating current, received the study that the latter system warrants, as a method of distributing electrical energy in our large cities.

With the installation of 60 cycle instead of 25 cycle high tension generators in the main power house, the flexibility of these plants is greatly increased, and their adaptation to lighting purposes would be a very inexpensive proposition.

There has been considerable controversy as to the stability of a 60 cycle rotary compared to that of a 25 cycle rotary. The argument had considerable weight before the advent of the turbine, but by having a rotating instead of a reciprocating engine for the prime source of power, the stability of a 60 cycle rotary is equally as reliable as that of a 25 cycle rotary, and therefore the 60 cycle current becomes just as suitable for direct current railway systems as the 25 cycle, and naturally is directly applicable for lighting and power service, and becomes readily convertible by static transformers for the various distributing systems required by a lighting installation. Particularly is this favorable for the central or business districts of a city as the installation of static transformer sub-stations is inexpensive compared with the large investment of copper or the frequent location of rotary stations with their attendant losses in efficiency and expense of maintenance.

It will therefore be interesting to see the relative advantages between an extensive installation on these lines for system such as is in use in the larger cities of this country.

As stated before, there are no advantages in a 25 cycle over a 60 cycle system for the direct current railway output, therefore the costs and efficiencies for this part of the equipment will remain the same, as in both instances standard rotary converters would be required.

For the lighting and power systems the advantage would be that due to the difference in efficiency and cost of the necessary converter apparatus for the direct current system and frequency changes for the alternating current system, as against static transformers. The latter would eliminate the following disadvantages:

First—Two transformers for each kilowatt output, namely, from high tension to low tension alternating current through static transformers, and from low tension alternating current to direct current through rotary transformers.

Second—The installation of three kilowatts of apparatus for each kilowatt of output, namely, one kilowatt in main station generators, one kilowatt in static transformers, and one kilowatt in rotary transformers.

Third—The large investment in copper for feeders to economically distribute large quantities of copper.

Fourth.—The maintenance of two systems of distribution, as the direct current is not suited for the outlying suburban districts, and would, therefore, require alternating current to cover this portion of the territory.

The usual practice in operating a direct current system from high tension alternating power plant requires the installation of frequent sub-stations equipped with standard apparatus, consisting of necessary transformers, regulators and rotary converters. From this the current is distributed through the usual low tension switchboard, feeders, mains, etc., to the customer's premises.

For an alternating current system the current would be taken directly to static transformers, which would be placed at such locations as the concentration of load would indicate, and would be located at more frequent intervals than rotary sub-stations, thereby avoiding the extensive system of feeders, as the current would be taken directly from the low tension side of the transformers to the mains.

In comparing the efficiencies of an alternating current and direct current system the calculations were based on the assumption that the static transformers were to be located at the same points as rotary sub-stations and in units equivalent to the direct current rotary converters and cut in and out of use similarly to rotary apparatus as the load increased or diminished, using the usual system of feeders as employed on a direct current system to distribute the load to the mains. These calculations gave the efficiencies of the alternating current system installed as above described and of a standard rotary sub-station system, for various loads from a full load to a quarter load, as follows:

Full load A. C. system, 21.4 per cent; full load D. C. system, 27.6 per cent.

Three-quarter load A. C. system, 17.2 per cent.; three-quarter load D. C. system, 23.4 per cent.

One-half load A.C. system, 13 per cent.; one-half load D. C. system, 19.7 per cent.

One-quarter load A. C. system, 8 per cent.; one-quarter load D. C. system, 17.1 per cent.

These efficiencies are taken from actual tests, or guarantees from manufacturers. The losses on the low tension feeder system were in either case assumed to be equal, although if the static transformers for sub-stations were located more frequently (as they could be readily placed in basements of large buildings) the losses on feeders could be practically eliminated.

From these figures it leaves no doubt as to which is the most efficient system, as under any condition of load the alternating current system will operate with from 6 to 9 per cent. less loss than a direct current system.

The next important question is the comparative cost of the installation. The calculations were based on a station having a capacity of 15,000 kilowatt full load output. This showed a saving on the cost of apparatus and buildings for sub-stations alone of $130,000, which is entirely due to the smaller space required for static transformers, and the difference in cost between the necessary converting apparatus from alternating to direct current as compared with the cost of static transformers for the alternating system.

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* Paper read at the 13th annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 18-20, 1905.

We, therefore, have as an increased economy up to the customers' premises on the alternating current system the saving due to the difference in losses, the saving on interest due to the smaller investment and the saving on depreciation due to simple installations, which amounted, on the installation referred to, to somewhat more than $75,000 per year, the output of the previous year being used on which to calculate the value of the losses.

So far the investigation from a financial point of view leaves no question as to which system of distribution to adopt.

The next question to receive consideration is the relative commercial value of the two currents, and it is on this question that the difficulty is encountered of persuading the interests controlling the large direct current systems to change to an alternating current system.

After a most exhaustive investigation of this part of the question there was found, in a city of some 600,000 inhabitants, no installation which is now served by a direct current system, which could not be served equally as well, if not better, by an alternating current system.

As to purely electric lighting service the alternating current is more suitable than the direct current, giving a greater variety of uses, as well as a more effective means of distributing light. The incandescent lamp is equally effective on both systems, so also the arc lamp, while the Nernst lamp adds materially to the advantages of alternating current lighting, and the ability to do decorative lighting by means of low voltage lamps through the introduction of transformers opens a field of economy in this class of work which could not be attempted with direct current.

For ordinary power work the alternating current motor is superior to the direct current motor, as the abolishing of brushes is a decided advantage where a large number of small motors are in use. In looking up the trouble calls from power customers it was found that fully 75 per cent. were due to brush or commutator trouble.

The greatest difficulty to overcome is the variable speed motor customer, but as this class of service is limited to the larger users of power, they could be readily accommodated by the installation of motor generator sets for each individual case.

The operation of elevators is also difficult to take care of with the alternating current motor, but with the development of the single-phase railway motor a suitable elevator motor cannot be far off, and all that is needed is the creation of a demand for apparatus of this class, when, no doubt, our associate members will be ready to supply the demand.

In conclusion it might be stated that on the favorable showing made by this investigation, a change has been made from a direct current three-wire Edison system to an alternating current, 60-cyle, single-phase system in the city of Racine which is an active manufacturing town and has a population of 30,000 inhabitants, and where every practical class of service was met that could be covered by a central station system.

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HIGH-TENSION SWITCHGEAR.*

BY L. ANDREWS, M.I.E.E.

(Concluded from page 51.)

We have always felt that no discriminating circuit-breaker that failed to comply with the following conditions could be considered a satisfactory protective device:

(a) An alternating current discriminating cut-out must not be released by a low resistance short-circuit beyond the cut-out.

(b) It must not be released by a current supplied to a highly-inductive load beyond the cut-out.

(c) It must not fail to be released should the prime mover driving the generator controlled be pulled up by a hot bearing or similar failure.

(d) It must not fail to be released should the field of the generator controlled break down.

(e) It must not fail to be released by a very heavy reverse current, even should the pressure across the bus-bars drop to as low as 20 per cent. of normal pressure.

There are other conditions equally important, but it will generally be found that a device that complies with the foregoing is also capable of dealing with other conditions.

Fig. 6 is a simple differential solenoid, the two windings of which are connected in parallel across any low tension source of supply, A—B, excited from the main bus-bars. These windings are parallel on one side through a small equalizer, upon which is wound one turn of the cable between the generator to be controlled and the main bus-bars. So long as there is no current in this series turn the current from the low tension source of supply divides equally between the bottom and the top winding of the differential solenoid, and its core is in consequence neither pulled up or down, but is held down by gravity. A generating current in the series turn will destroy the balancing effect of the equalizer, causing more current to flow through the lower coil and less through the upper coil of the differential solenoid, with the result that the core will be held down magnetically as well as by gravity. A reversal of the series current will induce more current to flow through the upper coil and less through the lower one, thus lifting the core and releasing the cut-out.

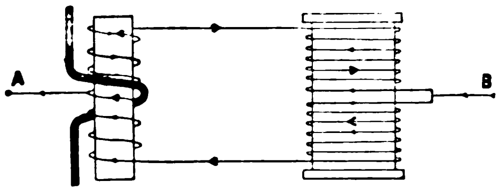

Fig. 6.

Here we have only two influences to consider. In the first place we have a simple series transformer, the secondary of which is closed through two solenoids connected in series; and, in the second place, we have two parallel circuits of equal ohmic and inductive resistance connected across a source of potential supply. When the induced secondary potential and the applied potential are in phase with each other, they will oppose each other in the upper winding of the differential solenoid and reinforce each other in the lower winding. When the respective potentials are 180 degs. out of phase with each other they will be in opposite directions in the lower and in the same direction in the upper winding.

The worst condition to be dealt with is that of a 90 degs. displacement of phase between the two potentials. In this case the effect upon the differential solenoid will be the same as if both coils were connected in series with the common return of a two-phase system. Two independent currents lagging 90 degs. behind each other will flow through both coils, and as they will be of the same value in each coil the coil will be neither pulled up nor down. This defect may obviously be corrected by inserting an inductive resistance in series with the potential supply A—B as suggested earlier in this paper. Another method of providing a cut-out that will take care of either a failing prime mover or a failing field is to use a double-barreled relay, consisting of two differential solenoids connected in parallel—a non-inductive resistance being inserted in series with one and a highly inductive resistance with the other. By this means the necessity of making adjustments in each case to determine the best mean point for both conditions, is entirely avoided.

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*Abstract of paper read at the meeting of the Manchester Section of the British Institution of Electrical Engineers, December 13, 1904.

We sometimes find that engineers are a little uncertain as to whether discriminating cut-outs or reverse current cut-outs should be used in certain positions. The following rule appears to apply to all cases:

"Where current is fed into bus-bars from a number of sources of supply connected in parallel discriminating cut-outs only should be used. Where current leaves bus-bars to supply a number of feeders, transformers, motors or distributors, excess current cut-outs only should be used."

We are often asked whether a discriminating cut-out should operate instantaneously or whether it should possess some time element. On the whole the advantages appear to be on the side of instantaneous action. It is certainly desirable that a generator breaking down should be cut out of circuit with as little loss of time as possible, and with a reverse current of something less than the full-load current.

Apparently the only argument in favor of a time-limit attachment is that a reverse current device without time element is liable to be tripped by the rush of synchronizing current from one generator to another when machines are being paralleled.

The simplest way of dealing with this difficulty appears to be either to switch off the shunt windings of the discriminating device at the moment of paralleling, thus rendering the device entirely inoperative or to greatly reduce the pressure across this winding when paralleling, thereby correspondingly increasing the reverse current required to operate the device.

DISCRIMINATING RELAYS AND CUT-OUTS.*

BY M. B. FIELD.

It is difficult to account for the mystery which is usually supposed to surround the design and operation of discriminating relays and cut-outs for alternating current circuits. For example, it is not infrequently stated that one type of relay (what is stated here with reference to relays is equally applicable to cut-outs) works well under certain conditions and fails to operate under other conditions; while a second type will perform its functions in the latter case, but breaks down in the former. Hence, a vague impression exists among many engineers that no relay (short of one possessing superhuman intelligence) can be expected to discriminate correctly in every one of the multitudinous cases which may be presented to it, and answer unfalteringly the vital question, "Must the circuit be opened or not?" That this impression, if it exists, is a mistaken one will here be demonstrated. The criterion as to whether a discriminating relay should operate under any given condition is a perfectly definite and simple one, as we shall see later on. In the writer's opinion much of the difficulty of the subject is solely due to the unfortunate designation "reverse-current" relay. This is undoubtedly a misnomer. What is exactly meant by reverse-current when dealing with alternating current circuits? In connection with continuous current circuits the phrase is a perfectly legitimate one, and presents immediately a definite conception. If we adopt the usual convention as to the direction of flow of a current we can consider a "forward current" as one flowing in the direction in which the EMF. acts, and a current flowing in the contrary direction as a "reverse current." Or we may adopt the convention that a current flowing into the "A" terminal of a given piece of apparatus inserted in the circuit (e.g., a relay), and out of the "B" terminal, is a forward current, apart from all consideration of the direction of the EMF. In this sense a polarized relay can discriminate between a forward and reverse current without reference to the EMF. at all. Such a polarized relay is undoubtedly the correct principle to adopt in the case of continuous current circuits, since its action and adjustment is independent of all variations in the supply voltage. Thus, should an excessive reverse current occur which had the effect of reducing the supply EMF. to nearly zero value, the relay would still operate, while a forward current, however large, would be ineffective in this respect.

In the case of an alternating current circuit the matter must be approached in a different way altogether. A current which at every instant is flowing in the direction in which the generated EMF. acts is undoubtedly a "forward current," while a current which at every instant flows in the opposite direction is a "reverse current;" the first is in phase with the EMF., the secondis 180 degs. out of phase. This is all quite obvious, but what about the current lagging or leading by 90 degs.? During half of each cycle it is flowing in the same direction as the EMF.; during the other half cycle it is flowing in the opposite direction. Such a current is consequently neither a forward current nor a reverse current, and whatever its magnitude should not cause a so-called reverse current device to operate.

Now, let us consider a current which lags, say, a little more than 90 degs. behind the EMF. (Fig. 1). We have then flowing in the circuit two currents superimposed, viz., O A and O B; not figuratively, but actually and really, these two currents exist. Now O A is, as we have seen, neither a forward nor a reverse current—as far as the relay is concerned it is a nonentity; O B is then the only current we have to consider, and it will be noted that it is the power component of the current C. In Fig. 1, O B is at every instant flowing in the opposite direction to the EMF.; hence, although the current C flows in the circuit, the reverse current is not C but O B. Had C lagged behind the EMF. by an angle less than 90 degs. (Fig. 2) there would have been no reverse current, but a current of amplitude O B' flowing in the same direction as that in which the EMF. acts.

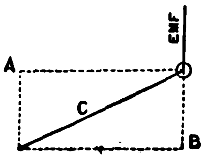

FIG. 1.

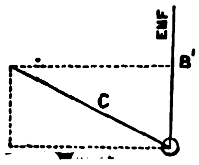

FIG. 2.

The criterion, therefore, which must alone decide the operation of a successful relay is: Is the power component of the current in the same direction or opposite direction at every instant to that in which the EMF. acts?

Having determined the specific condition or criterion which decides whether the ideal relay must operate or not, it is obvious that we have also determined the condition which must be made the controlling principle of the relay—in other words, the working principle of the relay must be so chosen that whenever this specific condition is absent, no matter what the other circumstances of the case may be, no tendency to operate is experienced by the relay. On the other hand, given the specific condition, viz., the existence of a reverse power component of the current, however small, a tendency to operate must be experienced by the relay. We do not say the relay must operate; it may be inconvenient to make it too sensitive, or it may be wished to introduce a time element, but we reiterate that if the current has a component representing reverse power, however small, a tendency to operate will be experienced by a properly designed relay, while a component representing forward power, though it may be large enough to destroy the relay, will not produce any tendency to actuate its mechanism.

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*From the "Electrical Review." London.

In the past numerous relays have been designed, which, in given circumstances, have proven unsuccessful, and the reason for this has not been that they were too sensitive or not sensitive enough, that they were too sluggish, or not sufficiently sluggish, but simply that the underlying principle controlling their movements did not necessarily coincide with or involve the single criterion which alone must determine the action of the successful relay. Thus, whereas the two conditions (viz., that which actually controlled the relay mechanism, and that which theoretically alone should control it) in numerous cases were co-existent, they were not necessarily so, and instances arose when this was not the case; hence the failure of the relay.

The question therefore arises, how are we to enable the relay to judge whether the main current contains a reverse power component? Clearly we must provide the relay with a sample of both the main current and the supply EMF. (in this latter respect it differs radically from the continuous current device). These samples which must be produced in their correct phase relations, are usually obtained by the aid of current and potential transformers. We must then leave it entirely to the relay to discriminate.

If properly designed it will sift out the power from the wattless component of the current sample, compare this as regards direction with the sample of EMF. and make up its mind accordingly.

How, then, must the relay be constructed to enable it to achieve this result?

A simple differential solenoid is manifestly wrong, since a current, whether forward, reverse or wattless, if large enough to swamp the effect of the shunt winding, would operate the relay. Such was pointed out by Mr. Leonard Andrews in his recent interesting paper on the subject, read before the Manchester Section of the Institution of Electrical Engineers.

An obvious way to meet the case is by the use of a wattmeter relay, pure and simple, since reverse current (as previously defined) cannot exist without reverse power. Clearly such a device will tend to operate with the smallest amount of reverse power and will exhibit no such tendency with any amount of forward power. If, therefore, it can be made sufficiently sensitive to operate with the smallest amount of reverse power which constitutes a dangerous condition, it is evident that it will theoretically form an ideal relay. This principle was also mentioned by Mr. Andrews in the paper referred to as first suggested many years ago by Dr. S. P. Thompson.

The necessity for a sensitive device becomes at once obvious when we consider that, although the actual current flowing be large, the power component of the same may be very small. This is the real difficulty experienced hitherto with compound differential devices. It is manifestly incorrect to introduce, for this reason, spurious phase differences, as suggested by Mr. Andrews. This is merely overcoming one trouble, and introducing the possibility of another—inoculating the vaccine in order to prevent smallpox. If we introduce spurious phase differences between the samples of EMF. and current, we shall find that with certain defined phase relations between main current and EMF., the relay will operate when it should not, and fail to operate when it should. True, the conditions involving these particular phase relations may rarely be met with in practice; they are, nevertheless, real and possible, and such a relay depends for its working principle upon a condition other than the criterion which should determine its action. Having shortly dealt with wattmeter relays, we may touch upon compound differential devices. Several forms of these have been suggested.

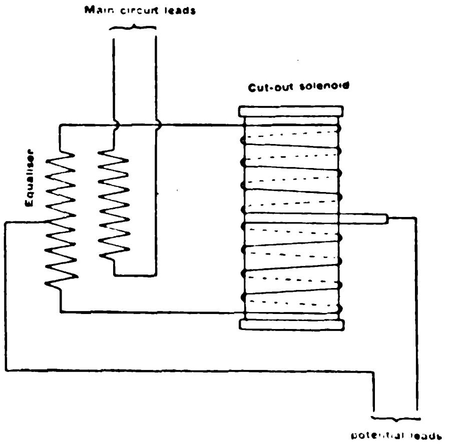

FIG. 3.

The principle consists in two solenoids pulling a single armature in opposite directions. In the one solenoid the effects of the samples of current and EMF. are added, in the other, subtracted. Imagine an armature symmetrically placed between the two solenoids, or two halves of a single solenoid, the magnetic circuit being such that the pull due to either solenoid is proportional to the square of the ampere turns. The resultant pull at every instant will be proportional to$(v + c)^2 - (v - c)^2$, or 4 v c, where v and c represent the samples of EMF. and current respectively. The foregoing expression obviously represents watts, that is, the mean pull on armature is proportional to the average watts of the circuit, and will, therefore, be in the one direction in the case of reverse power, in the opposite direction in the case of forward power. We have introduced this—a purely hypothetical and ideal relay—on account of its similarity with the devices suggested by Mr Andrews.

In the device shown in Fig. 3, which is advocated by Mr. Andrews, the current in the top half of the solenoid corresponds to the difference (v — c), and that in the lower portion to (v + c). It is obvious that there is as much need for delicacy in this as in any other type. Sensitiveness, however, is not compatible with the particular design chosen, hence the reason for introducing spurious phase differences, which are wholly undesirable for reasons already pointed out.

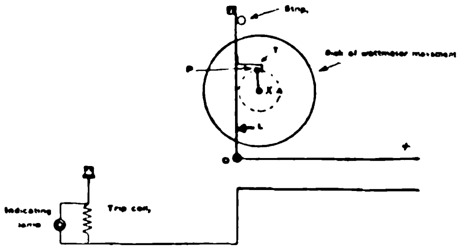

FIG. 4.

The relays will operate with any reverse power down to 10 per cent. of the full load of the circuit. This is found sufficiently sensitive to protect the average generator if the field circuit be opened—the severest test of a reverse-power indicator. A more sensitive device is not to be recommended. These relays can be made with and without time element. Fig. 4 shows diagrammatically the action of the relay. A weighted contact lever, L, pivoted at O, stands vertically. The wattmeter movement rotates about the axis, X (at right angles to paper), in a counter-clockwise direction with reverse power, and tends to rotate in a clockwise direction with forward power. Thus, the arm is posively held upright by the pin, P, in the wattmeter disk engaging in the projection, T, of the contact lever, as long as the transmission of power is in the forward direction. On a reversal of power the wattmeter rotates in the counter-clockwise direction, and the pin P impinging against the lever causes it to overbalance and fall into the horizontal position, thereby establishing the trip coil and indicator lamp circuits.

Another device is a polarized reverse current relay for direct current circuits. In this the serious disadvantage is absent under which all relays labor which have shunt and series coils combined differentially, viz., that the main current at which the device operates is largely affected by variations in the EMF. supplying the shunt winding. Further, it is found that many such differential devices will operate with a forward current if sufficiently large to swamp the effect of the shunt winding. For example, a partial short-circuit which momentarily causes a drop in the EMF. frequently causes so-called reverse current devices of the differential type to operate.

This relay is independent of the EMF. as regards its action and adjustment; and, if provision be made for supplying the trip coils from a separate source, the action is as certain, though the EMF. drop to zero, as if no variation in it occurred.

Where a separate source is not available for the trip coils, it is best to design the latter to operate with certainty at one-third normal bus-bar volts, and to withstand the application for five minutes of the full normal supply voltage. Fig. 5 shows diagrammatically the connections of this relay.

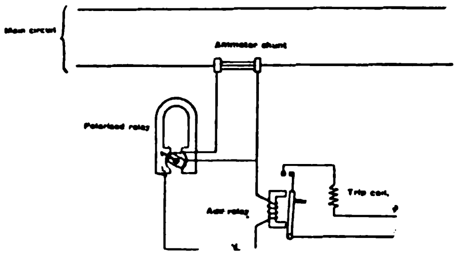

FIG. 5.

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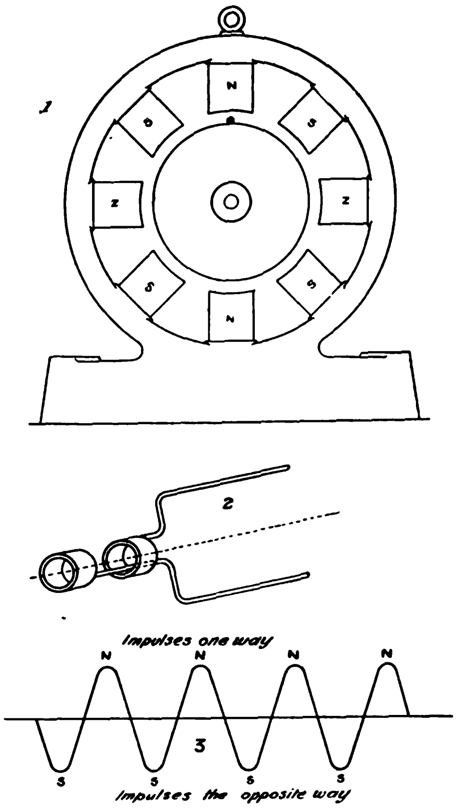
ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

THE DYNAMO.

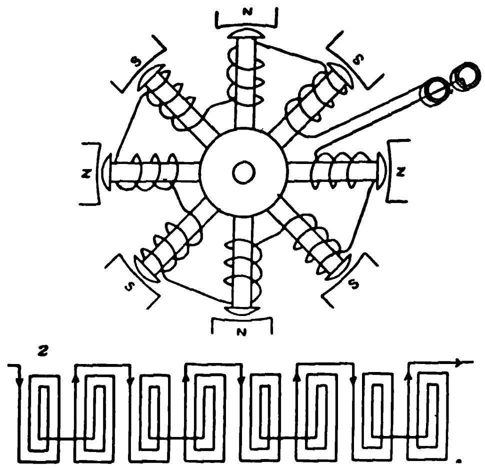
Kinds of Alternators.—There are several varieties of alternating current dynamos, distinguished from each other by an interesting peculiarity called "phase." To enumerate, there is the single phase, two phase and three phase dynamo. The meaning of phase may be readily understood with reference to the character of the currents they individually produce; and to accomplish this it is necessary to represent these differences partly by diagram.

The Single Phase Dynamo.—A wire on the armature of an alternator rotates past a series of poles of different polarities. It passes a north pole, then a south pole, a north pole and a south pole, and so on, as it continues its rotations. Every north pole it passes produces an impulse in the same direction; that is, all one way, and every south pole it passes produces an impulse in the opposite direction. Thus, the impulses of current due to the north poles are all in one direction and the impulses of current due to the south poles are all in the opposite direction. This idea is represented by a series of curves placed over or under a line. All the curves or waves over the line can be regarded as impulses due to north poles and those under the line as impulses due to south poles. Therefore a diagram of this character adequately represents in each two curves, one above and one below, the increase and decrease of the EMF., as the conductor sweeps past a north pole; the particular instant at which no EMF. is generated just as the conductor has emerged from the lines of force of the north pole and is about to enter those of the south pole; then the rise and fall of the EMF. due to the south pole with a return to practically the same conditions as the cycle is about to be repeated. Each pole is capable of producing one wave of EMF. in a conductor, and in consequence it is customary and necessary to depict this process of EMF. development by a curve as described. The name given to a curve of this character by mathematicians and so called by electricians is "the sine wave." It corresponds so closely to this curve that many of the most valuable formulas in use for the calculation and design of alternating current machinery have been obtained through this fortunate coincidence.



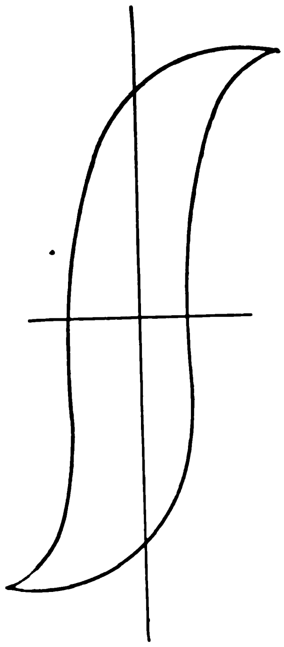
1—Conductor on Armature of 8-poled Alternator, Producing 4 Complete Alternations per Revolution. 2—End Connections to Collector Rings. 3—Wave of Alternating EMF.

Connections of an Alternator Armature.—A great many impulses occur in the winding on the armature of an alternator every time the conductors pass each pole. It has been necessary to devise a winding which would throw all similarly moving currents in one direction and thus avoid opposition between them. This is readily done by laying flat coils on the armature each around a projecting core and connecting their ends together, the outside terminals of adjacent coils and the inside terminals of those next adjacent, and so on, until the two final ends are connected respectively to collector rings, from which by means of brushes an impulse is collected as the coils on the armature pass a pole piece.



1—Radial Poled Alternator, Showing Armature Winding. 2—Connections of Alternator Armature Coils.

Hysteresis.—The iron core of the armature is magnetized first one way and then another, whether it belong to an alternator or a direct current dynamo. The effect of this is to consume power which manifests itself as heat. It makes no difference whether the iron have the highest magnetic conductivity or not this phenomenon always makes its appearance when iron is magnetized and demagnetized. The reason why power is consumed is as follows: When a bar of iron is magnetized by means of a coil carrying a current and the ampere turns or magneto-motive force is great enough to saturate it, the molecules of iron assume a certain polarized position. If an equal and opposite magneto-motive is applied by means of the coil the iron *will not* return to its normal condition; it will require extra magnetizing force to accomplish this, and if the process is continued until the iron is magnetized as highly in the opposite direction (with reverse poles) as before and then brought back to where it started from, it will be found that a considerable amount of power has been absorbed. A process of this kind is called a cycle of magnetization, and although it merely consists of the magnetization and reverse magnetization of iron with a final return to the starting point, yet each instance is an opportunity for power to be absorbed, which increases as the degree of magnetism to which the iron is subjected increases and also as the rapidity and frequency with which such operations are conducted per second. If a cubic foot of soft iron is put through such a process, according to a noted authority, when magnetized up to 60,000 lines of force per square inch, it will absorb 10 foot pounds of energy. If the process is carried on at the rate of 100 times a second, 1,000 foot pounds of energy are absorbed. It is easy to estimate that each minute would represent a power consumption of 60,000 foot pounds or nearly 2 hp. at this rate of change. All armature cores, therefore, must be calculated with respect to such a dissipation of energy and it is necessary to obtain figures which will enable such calculations to be carried out. Before presenting the formula discovered by Steinmetz, upon which all calculations of hysteresis (the name given to this property of iron) are based, it is evident that a heavily magnetized piece of iron, unless slowly magnetized and demagnetized, would develop a great deal of hysteresis, as well as a piece of iron moderately magnetized but subjected to a very rapid series of such changes. When alternating currents are used for this purpose, therefore, the iron must not be heavily magnetized and the same is true for the armatures of both direct and alternating current dynamos.



Hysteresis Curve. Showing Nne Complete Cycle of Magnetization.

The Steinmetz Formula.—The formula is a little difficult at first sight to those unaccustomed to the handling of symbolic forms, but the table will supply any deficiencies in this respect. In the formula a constant is multiplied by the lines of force per square centimeter, bearing the exponent 1.6, or the power consumed in one magnetic cycle for one cubic centimeter of iron is

Power consumed = .002 × (lines of force per square centimeter) $^{1.6}$,

in which .002 is called the hysteretic constant, which averages up for all samples of pure iron as shown:

Wrought-iron—hysteretic constant. .0017
Cast-steel—hysteretic constant.... .0025

The above formula reduced to symbols would appear as follows for one cubic centimeter of iron :

$$W = .002\, B^{1.6},$$

where W = ergs,
B = lines of force per square centimeter.

The value of an erg is best understood by those most familiar with the English system of units with reference to a foot pound. A foot pound equals 13,350,000 ergs. In the following table, in which the lines of force per square centimeter and per square inch are given, complete calculations are made by the Steinmetz formula for iron subjected to a series of increasing magnetizations :

FLEMING'S TABLE.

Lines of force per sq. cm.	Lines of force per sq. inch.	Ergs per cubic cm.
1,000	6,250	126
2,000	12,500	383
3,000	18,750	732
4,000	25,000	1,160
5,000	31,250	1,658
6,000	37,500	2,222
7,000	43,750	2,840
8,000	50,000	3,516
9,000	56,250	4,244
10,000	62,500	5,022

To use this table, the number of complete reversals of magnetism per second must be multiplied into the waste of power per cycle. For instance, if the frequency of an alternating current is 120 per second, a well known commercial rate for lighting circuits, the power wasted at 5,000 lines of force per square centimeter or 31,250 per square inch would be 3.21 foot pounds for a cubic foot of iron per complete reversal. For 120 complete reversals the power wasted would be 120 × 3.21 = 386 foot pounds.

In reference to the erg it may be stated that one pound = 445,000 dynes. A dyne, as previously explained, is the force required to impart to a gram a velocity of 1 centimeter per second. An erg is *the work* done in moving a body a distance of 1 centimeter against a force of 1 dyne. If a gram is moved against gravity a distance of 1 centimeter in 1 second 981 ergs of work are done. A pound is equal to 445,000 dynes because it weighs 453.59 grams, and the force of gravity equals 981 dynes per gram, that is to say, it takes 981 dynes to *impart* a velocity of 1 centimeter per second, or what is the same thing, a mass of 1 gram falls with a velocity of 981 centimeters per second; thus 453.59 × 981 = 445,000 dynes or 1 pound. If 1 pound is moved 1 foot it means a force of 445,000 dynes operating over a distance of 30 centimeters, the basis of estimate being .4 inch per centimeter and therefore 30 centimeters per foot. This calculation gives 445,000 × 30 = 13,350,000 ergs = 1 foot pound. If the last column of figures, which give the energy wasted in ergs, are given in the English system for 1 cubic foot of iron magnetized and demagnetized at the rate of 120 times a second, the following figures appear:

POWER WASTED PER CUBIC FOOT OF IRON AT 120 REVERSALS PER SECOND.

Lines of force per sq. inch	Lines of force per sq. cm.	Ergs per cu. cm.	Ergs per cu. ft.	Foot pounds per cubic foot.
6,250	1,000	120 x 126	40,824	29.32
12,500	2,000	" " 383	124,092	89.13
18,750	3,000	" " 732	237,168	178.00
25,000	4,000	" " 1160	375,840	270.00
31,250	5,000	" " 1658	537,192	386.00
37,500	6,000	" " 2222	719,928	517.06
43,750	7,000	" " 2840	900,160	661.00
50,000	8,000	" " 3516	1,139,184	818.17
56,250	9,000	" " 4244	1,375,056	987.6
62,500	10,000	" " 5022	1,627,128	1168.6

For armature cores this last table is very useful, also in those cases where the use of magnets on alternating current circuits are proposed. In alternating current work in general, whether single, two or three phase, of necessity dynamos, motors and transformers are in almost constant use; and these machines call for the application of the principles outlined so far as hysteresis is concerned, otherwise the internal development of heat within the iron would not only waste power but rapidly put a stop to the operation of such machines altogether.

Two and Three Phases.—If another current follows after the first impulse of an alternating current, but not so slowly that it differs in any respect from the first except in being an instant behind it, there are what are called two phases acting in the circuit. If three distinct currents follow each other in this manner, each an instant behind the other yet not so far behind that the three currents are not at some stage of growth or diminution at the same moment, there are three phases of current in the circuit or it represents a three-phase current.

Phases of this kind are produced in a very simple manner. The armature conductors are connected in such a way that in the case of a two or three-phase dynamo practically two or three distinct windings are in operation at once. In one winding the armature conductors, for instance, are one-third of the distance across a pole piece before the second winding is in operation. By this means the beginning of an impulse is one phase, which follows all the laws of an ordinary alternating current. The phase beginning when the first conductors have already been developing EMF. along one-third of the arc of the pole piece also rises to its full value and acts like the first phase. A third can follow in the same manner if the conductors are so arranged and connected to individual collector rings. Thus, instead of only one—two, three or more phases or currents can be developed by this method each distinct from the other, an instant behind it and serviceable for electric lighting and power transmission. Rotary converters found in power houses and sub-stations and nearly all self-starting alternating current motors are actuated by multiphase currents of either two or three phase.

THE ELECTRIC LIGHTING OF RAILWAY TRAINS.*

BY DR. ALFRED GRADENWITZ.

The system of electric lighting for trains described in the following was designed by Mr. Aichele, and is being brought out by the Aktien-Gesellschaft Brown, Boveri & Co., of Baden, Switzerland. In this system each car has a lighting plant of its own, consisting of a dynamo, a storage battery of some few cells, the regulation device, conductors and lamps. This will greatly increase the value of this system, which may be applied both to ordinary and express trains.

The dynamo, which is suspended in the middle of the truck, is a shunt machine of about 2 hp., being inclosed in a dust-tight cast-iron housing, and driven from one axle of the wagon by a belt. Its speed will thus, in any case, be proportional to the speed of the train. On the direction of the latter being reversed, its poles are changed automatically by shifting the brushes on the commutator. The storage battery includes 9 or 2 x 9 cells of a capacity of about 140 ampere-hours, corresponding to a lamp voltage of 18 or 36 volts.

The internal arrangement of the apparatus is shown in Fig. 1, the essential parts being the switching apparatus, C, and the regulating motor, R. The core of the apparatus is raised under the influence of the thin wire coil, a, connected to the terminals of the dynamo (see diagram of connections, Fig. 2) or of the apparatus, C, as soon as the train exceeds a speed of about 15 miles per hour, when the voltage at the terminals of the dynamo has reached the battery voltage. On the speed of the train being further increased, the battery will begin to be traversed by the charging current, passing through the second coil, b, of the switching apparatus, C, where it acts in the same way as the current in the coil, a, thus securing the connection between the dynamo and battery, which has been completed by the latter. At the same time, the regulation motor, R, will, however, be set working as soon as any machine current is developed, thus effecting an automatic adjustment of the shunt regulation resistance of the dynamo which controls the current supplied by the latter.

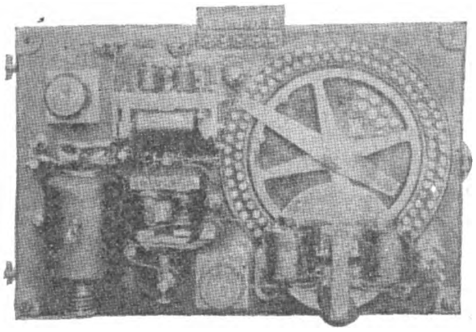
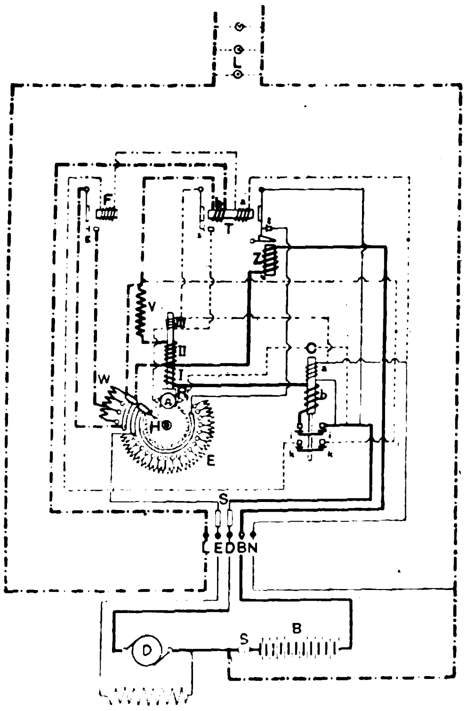


Fig. 1.
View of Regulation Apparatus.



—Diagram of Connections.

Fig. 2.

The motor magnets bear three independent exciting coils, marked I, II and III, respectively, in Fig. 2. As long as there are no lamps switched in, the coil I, traversed by the machine current, and III, which is applied to the battery terminals, will work simultaneously. If any lamps are thrown in, the coil III will be replaced by the coil II, which is traversed by the lighting current, so that the coils I and II now work simultaneously. Under the action of I, the lever, H, will be displaced so as to effect an increase, and under the action of II or III a diminution of the resistance in the exciting circuit of the dynamo. In both of these cases the lever, H, will thus be adjusted under the influence of two magnet coils of the regulation motor, acting in opposite rotary directions, so as to weaken the excitation of the dynamo as soon as the effect of the coil I traversed by the machine current becomes the stronger, on account, for instance, of an increase in the speed of the train. The lever, H, will then slide on the contacts of the shunt regulation resistance, E, as the speed of the train increases until the effect of the coil I corresponds accurately to the effect of the coils II or III, thus balancing the latter. If this state of equilibrium is attained, the motor will remain at rest until, on account, for instance, of a decrease in speed, the equilibrium of the two magnetizing coils of the motor is once more disturbed, when the motor, under the influence of the now prevailing coil II or III, turns the lever at the regulation resistance in an opposite direction, so as to increase the excitation of the dynamo, until the charging current traversing the coil I has returned to its previous value, thus re-establishing the equilibrium between the coils I and the antagonistic coil. By applying to the coil III the voltage of the battery there is thus obtained, in the first case, a regulation to constant intensity of the charging current, while, in the second case, by causing the lighting current to traverse the coil II the charging current is adjusted automatically in accordance with the lighting current, and at the same time the increase or decrease of the latter charging current is regulated by increasing or decreasing by steps the effect of the coil II (traversed by the lighting current) through a gradual modification of a resistance inserted in parallel.

During the stoppage of the train the connections between the dynamo and the battery, B, will be interrupted in the switching apparatus at i i (Fig. 2) when the lamps derive their current from the accumulator battery. The lever, H, has been placed during the preceding stoppage of the train owing to the action of the coils II (traversed by the lighting current) on the magnet of the electromotor, R, in the extreme position shown in Fig. 2, where the shunt regulation resistance and the coil II, inserted in the lighting circuit, as well as the shunt resistance V, before the lamps, are short-circuited. The lighting current will, therefore, in the beginning exert no magnetizing effect on the magnets of the electromotor, R, the lamps being applied to the battery terminals without any shunt resistance. The relay, T, having attracted its armature under the influence of the coil b, traversed by the lighting current, the contact will be completed, and the coil III will be out of action.

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*From the "Electrical Engineer," London. Abstract.

On the train starting there will, as soon as the speed of the dynamo has become sufficiently increased, be a dynamo voltage equaling the voltage obtaining at the terminals of the battery, when the magnetizing effect of the coil a in the switching apparatus, C (which is being permanently applied to the terminals of the dynamo) suffices to lift the core of the apparatus, thus completing the connection between the dynamo and battery. The corresponding speed of the train is about 15 miles per hour. If the speed increases further, the tension at the terminals of the current generator will be augmented so that the battery is traversed by a charging current. This current, traversing the coil b of the switching apparatus, C, will act there in the same sense as the current in the coil a, that is to say, will secure the connection between the dynamo and battery that has been effected by this coil. In addition, the charging current will, however, traverse the magnetizing coil I of the electromagnet, turning the lever, H, from the extreme position to the nearest contact of the resistance, W. Instead of the short-circuit, part of the resistance, W, will now be placed in parallel to the coil II and the shunt resistance, V, when part of the lighting current traverses the coil II, which by its magnetizing effect balances the coil I traversed by the charging current, so that the lever is stopped in this position, until on account of the increasing speed of the train the effect of the machine current in the coil I becomes stronger. Then the lever, H, turns on to the second contact of the resistance, W, thus altering once more the distribution of the lighting current in the two parallel branches, so that the portion traversing the coil II and the shunt resistance, V, becomes greater and compensates for some moments the machine current traversing the coil I. The lever, H, will thus stop also in this second position for some moments, until the machine current becomes sufficient to move it on. During the increase of the charging current the lever, H, thus slides slowly over the various contacts of the resistance, W, while the portion connected in parallel to the coil II and the shunt resistance, V, increases continually until it becomes infinite, when the lever, H, has left the contacts of W. The shunt resistance connected to the lamp, and which consists of two parallel branches (coil II and shunt resistance V, on one side, and inserted portion of resistance, W, on the other) will thus be increased by steps which are adjusted automatically according to the actual intensity of the increasing charging current. The fall in voltage undergone by the fixed lighting current in this variable combined resistance thus corresponds at any moment to the increase in voltage at the battery terminals, due on one side to the disappearance of the discharging current, and on the other to the increase of the charging current. After the lever, H, has left the contacts of the resistance, W, on the train being further accelerated, the full amount of lighting current will traverse the coil II. The adjustment of the lever is effected by the simultaneous action of the two antagonistic coils, I and II, which are traversed by the machine and lighting current respectively. The zero position of the lever with the various speeds of the train corresponds always to an intensity of the charging current that bears a constant ratio to the intensity of the lighting current. The former will, therefore, undergo an alteration only in the case of the number of lamps inserted being altered, increasing and falling along with the lighting current.

In case the running speed decreases the electromagnet would, under the magnetizing influence of the constant lighting current, first move the lever, H, into positions corresponding to the smaller resistances in the shunt circuit of the dynamo, until the lever, H, has reached the contacts of the resistance, W, when the resistance is connected in parallel to the coil II, and the shunt resistance, V, so that the same process as on the starting of the train occurs in an inverse order, namely, a slow decrease of the charging current occurring by steps and being accompanied by a step-by-step diminution of the shunt resistance connected to the lamp. The charging current will have disappeared completely after the lever has returned to the first contact of W, when in the switching apparatus there will only be left the attracting effect of the coil a, which just suffices to maintain the core of the apparatus in the attracted position. The voltage of the dynamo has again reached the value with which the core of the switching apparatus, C, was attracted, thus being equal to the accumulator voltage. In the subsequent moment the dynamo voltage will, on account of the further decrease in the speed of the train, fall below the voltage of the accumulator battery, the core of the switching apparatus, C, dropping so as to discontinue the connection between the dynamo and battery. This decrease in the charging current and break in the connection between the dynamo and battery occurs without the luminous intensity being altered to any appreciable degree.

As soon as the perfect charge of the battery has been attained, the charging current disappears automatically, any switching made for its regulation occurring automatically and exerting no appreciable influence on the candle-power of the lamps. When all the lamps are switched off the lighting circuit the effect of the coil b on the core of the apparatus T will accordingly disappear. As the complete charge of the battery is reached the increase of voltage obtaining in the final charging condition at the accumulator terminals will be sufficient to produce the attraction of the core of the electromagnet, T, thus completing the contact, S, and discontinuing the effect of the coil III on the magnet of the electromotor. The latter, will, accordingly, under the action of the magnet coil I (which is traversed by the charging current) adjust the field excitation of the dynamos to smaller values until the charging current has disappeared completely. The present regulation system thus regulates the charge of the accumulator battery in the same way as in a stationary plant.

* * *

The Institute's Annual Dinner.

The preparations for the annual dinner of the American Institute of Electrical Engineers are being pushed actively and the affair promises to be a great success. It will be devoted, as already announced, to signalizing the triumphs of electric traction. President Lieb has appointed the following committee, which is already at work: Messrs. T. C. Martin, chairman; W. C. Gotshall, L. B. Stillwell, H. G. Stott, Calvin W. Rice, F. C. Bates, H. W. Blake, P. G. Gossler, E. B. Katte, C. W. Price, W. A. Pearson and W. L. Conwell. This committee has organized and sub-committees are at work on different features of the banquet. Some original and novel features will be included, and it is believed that the oratory will be unusually interesting. Messrs. Frank J. Sprague and Leo Daft are to speak for the Institute pioneers in this great field of electrical development. The banquet will be held in the grand ball-room of the

Waldorf Astoria on February 8, and it is expected that between 400 and 500 will be present, including many ladies. Tickets are $5 each, exclusive of wine. It may be mentioned that in addition to the features connected with the dinner itself, there will be exhibited, for the first time, the beautiful oil painting just presented by the British Institution of Electrical Engineers, as a souvenir of last year's visit, to the Institute, representing Dr. Gilbert making magnetic experiments before Queen Elizabeth. The bust of Prof. Ferraris, also presented to the Institute last year, will be exhibited in the Astor Gallery reception room.

Important Trolley Decision.

In the case of the Thomson-Houston Electric Company vs. Black River Traction Company, the Court of Appeals, sitting in New York, has rendered a decision sustaining the validity of the patent of Charles J. Van Depoele (deceased) for the well-known and almost universally used underrunning trailing-arm trolley.

American Institute Election.

Among those prominently mentioned in connection with the presidency of the American Institute of Electrical Engineers is Dr. S. S. Wheeler, at present serving as one of the Institute conferees on the Union Engineering Building joint board. Dr. Wheeler was one of the leaders 18 years ago in a movement to secure permanent quarters for the Institute.

Mr. Edison Recovering.

Mr. Thomas A. Edison is reported to be rapidly recovering from the operation which was performed upon him last week for the removal of an abscess which had formed in the mastoid process back of the left ear. The operation involved the opening of a channel through the bones of the skull.

New Wrinkle Editor.

Secretary Farrand sends us the following news item: "Mr. H. C. Abell, a business associate of Mr. Henry L. Doherty, has accepted the appointment of Wrinkle editor for the Denver-Colorado Springs convention of the National Electric Light Association. Mr. Abell has discovered a great many wrinkles in connection with central station operation, and knows where to learn of a great many more, that, acting homœpathically, will tend to remove wrinkles of care from the brows of all the central station managers fortunate or wise enough to be members of the association."

Standard Wiring.

Mr. H. C. Cushing, Jr., author of the hand book "Standard Wiring for Electric Light and Power," as adopted by the Fire Underwriters of the United States, has just brought out the 1905 edition of this book, completely revised to date.

Mr. Cushing, in revising this new edition, was successful in securing the services of Mr. F. E. Cabot, secretary of the Boston Board of Fire Underwriters, and chairman of the Electrical Committee of the Underwriters' National Electric Association, to assist him with that part of the book which treats of the underwriters' rules and requirements, and also the assistance of Mr. George T. Hanchett, consulting electrical engineer and member of the American Institute of Electrical Engineers, in checking up and revising many valuable tables and formulæ to aid practical wiremen and contractors in determining the proper sizes of wires for all manner of construction work for both alternating and direct currents.

This new edition, like all previous editions, is handsomely bound in flexible leather, and makes a most complete and accurate pocket companion for the practical electrical engineer, central station man, wireman and contractor, as well as an accurate guide for the architect and builder, many of whom are now called upon to embody, not only in their specifications, but in their plans, provision for the electrical construction in buildings and structures of all kinds.

"Standard Wiring" is recognized all over this country as the authority on electrical wiring and construction, being the only book on the subject which is revised and brought up-to-date every year.

All Due to Electricity.

The greatness of Greater New York has received a wonderful impetus by the successful adaptation of electricity to rapid transit. Few people whose business confines them to the city prefer to live on Manhattan Island, and when the rapid transit facilities which will be inaugurated within the so-called "electric zone" are perfected, there will be no excuse for their doing so. Then Tarrytown will be as near as Yonkers, and Yonkers will be brought within such easy access that Greater New York's growth to the north will result in a solid city for 25 miles from the battery along the Hudson. The birth of a new era in suburban growth is at hand.—*From " The World's Progress," in Four Track News for February.*

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JAN. 24, 1905.

Electric Railways and Appliances.

780,502. Third Rail. Alfred H. Hopkins, Chicago, Ill Filed Nov. 18, 1904.

780,568. Method of Controlling Electric Railroad-Brakes. John S. Lockwood, Kansas City, Mo. Filed April 16, 1903.

780,620. Trolley-Wire Finder. Joseph P. Reed, Muncie, Ind., assignor of one-half to Salathiel R. Babcock, same place. Filed Sept. 17, 1904.

780,698. Electric Railway. Frank Anstett, Wilkes-Barre, Pa. Filed Aug. 9, 1904.

780,767. Electric-Railway Trolley. Russia R. Weeks, Cincinnati, O. Filed April 14, 1904.

780,885. Railway Electric Signal. Slaughter W. Huff, Baltimore, Md. Filed Jan 17, 1898.

Electric Lights and Appliances.

780,523. Contact for Electric Hand-Lamp. George L. Patterson, New York City. Filed April 6, 1904.

780,613-780,678. Incandescent Lamp and Incandescent-Lamp Socket. Henry E. Meyers, Denver, Col., assignor to the Electric Flash Light Company, same place. Filed Nov. 24 and Dec. 11, 1902. Renewed June 20, 1904.

Electrical Machinery and Apparatus

780,503-504. Controller for Alternating-Current Electric Motors. Ray P. Jackson, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed June 6, 1904.

780,507. Apparatus for Testing the Insulation of Coils. Edmund W. Kellogg, Newtonville, Mass. Filed Oct. 6, 1904.

780,544. Thermal Cut-Out for Electric Circuits. Theodore Varney, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 22, 1902.

780,545. Means for Measuring the Energy of Alternating-Current Circuits. Miles Walker, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Feb. 28, 1903.

780,547. Starting-Switch for Electric Motors. John B. Wiard, Lynn, Mass., assignor to the General Electric Company. Filed May 27, 1904.

780,549. Explosive-Engine. John G. Callan, Lynn, Mass., assignor to the General Electric Company, Filed Sept. 4, 1903.

780,550. Electropneumatic Control System. Eugene R. Carichoff, East Orange, N. J., assignor to the General Electric Company. Filed June 30, 1904.

780,555. Electric Igniting System for Vapor-Engines. Albert E. Doman, Elbridge, N. Y., assignor to the Elbridge Electrical Manufacturing Company. Filed July 7, 1902.

780,580. Control of Electric Motors. George W. Remington, Schenectady, N. Y., assignor to the General Electric Company. Filed June 26, 1902.

780,724. Dynamo for Train-Lighting. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car Heating Company. Filed June 6, 1902.

780,754. Electrically-Operated Valve. Oscar Jungren, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 24, 1903.

780,769 770. Electric Meter. James J. Wood, Fort Wayne, Ind. Filed Feb. 11 and May 10, 1904.

Telephones and Telephone Apparatus.

780,525. Telephone-Dial. Charles D. Reeve, Grand Rapids, Mich. Filed June 9, 1904.

780,601. Central-Supply Telephone System. William W. Dean, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed March 22, 1901.

780,679. Apparatus for Telephone Switchboards. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company. Filed Jan. 26, 1901.

Miscellaneous.

780 564. Charging Storage Batteries John L. Hall, Schenectady, N. Y., assignor to the General Electric Company. Filed July 13, 1903.

780,663. Method of Operating Printing-Telegraph Receivers. John M. Joy, New York City, assignor to the Page Machine Company, same place. Filed Aug. 1, 1902.

780,664. Printing-Telegraph Receiver. John M. Joy, New York City, assignor to the Page Machine Company, same place. Filed Aug. 5, 1902.

780,842. Method of Receiving Electromagnetic Waves or Other Feeble Signal Impulses. Frederick K. Vreeland, Montclair, N. J., assignor to the Wireless Telegraph Exploitation Company, New York City. Filed Aug. 1, 1904.

THE TELEPHONE WORLD.

Big Telephone Deal Reported.

The Pittsburg "Press" on Friday afternoon last published the following introductory to a two-column article: "The stockholders of the American Telephone & Telegraph Company of New York will be notified in a month hence at the annual meeting to be held at Boston of a deal by the directors of the corporation through which the concern has secured an interest in 43 telephone companies in the United States, reaching from New England to the Pacific Coast and from the Gulf of Mexico to far into the territory of Canada. They will also be asked to authorize the executive committee to sanction the building of 90 miles of long-distance trunk lines to complete a transcontinental system which will enable the subscribers of the various companies interested to talk from Maine to San Francisco and from Texas to Canada."

National Organization to Compete With Bell Company.

Representives of various State associations of Independent telephone companies met last week in Indianapolis, Ind., and took preliminary steps toward forming the National Inter-State Telephone Association, which is organized for the purpose of forming a more compact body to compete with the Bell Company. The constitution adopted provides for the organization of the various States and districts traversed by the Independent companies.

The representation will be on a delegation basis, one delegate to be elected by the State or district association for every 10,000 units represented. The units are based on the number of telephones in use.

In a decision filed by the State Circuit Court at Cincinnati, O., it is declared that the Independent Telephone Company, organized to enter the Cincinnati field, has not yet secured the right to appeal to the courts for a franchise, some of the formalities as to the application to the city council not having been properly complied with. The case will be appealed.

The Colorado Telephone Company is sending out to its subscribers in Colorado Springs circular letters announcing a material reduction in service rates in that city as follows: One-party business lines from $100 to $72 per annum; one-party residence lines from $66 to $48; two-party business lines from $78 to $60, and two-party residence lines from $54 to $36.

The Bell Telephone Company has cut the rate from Monroe, Mich., to Toledo from 25 cents to 10 cents for three minutes' talk to meet the rate of the Stoddard Telephone Company, a Monroe Independent Company, and a merry 'phone war is now predicted.

The Michigan State Telephone Company has arranged to release the property of the Detroit Telephone Company. The receivers of the latter have obtained the necessary permission from the United States Supreme Court.

The Keystone Telephone Company of Philadelphia is to be reorganized as to finances, and its development otherwise facilitated without delay.

Iowa Telephone Men to Meet in March.

It is probable that at the annual meeting of the State Telephone Association to be held in Des Moines March 13 and 14 the arrangements for a clearing house, through which all toll line moneys will pass, will be made. At the meeting last year this was discussed, but the plan was not well worked out. Since that time further details have been arranged, and the plan will probably be adopted. Much interest centers in these meetings in view of the rapid growth of telephone companies in Iowa.

May Combine Independent Lines.

The consolidation of all the Independent telephone lines operating in the vicinity of Clearfield, Pa., was considered at a meeting of the directors of the Huntington & Clearfield Telephone Company and other Independent operators, held in Clearfield a short time ago. The prospective consolidation will result in the extending of the Independent line of the Huntington & Clearfield to Pittsburg, Philadelphia and other important places.

At the recent annual meeting of the York State Telephone Company, held in Elmira, stockholders were present from Philadelphia, Binghamton, Elmira and other places. The board of directors elected consists of 21 men, most of whom are from Pennsylvania. On the board are Thomas B. Crary, of Binghamton, and Eugene Dillon, Boyd McDowell, H. C. Mandeville, Myer Friendly and L. H. Murphy, of Elmira. The directors elected W. D. Barnard, St. Davis. Pa., president; Edward Davis, Philadelphia, vice-president; D. M. Yarnall, Philadelphia, treasurer; Boyd McDowell, Elmira, secretary, and George B. Wright, Binghamton, general superintendent. A proposition to reduce the capital stock of the company was brought up, but after slight discussion, action on it was postponed for three months.

The citizens of Chapel Hill, Tenn., and vicinity, have decided to have a telephone exchange at that place. They will secure a switchboard from the Cumberland Telephone Company and will furnish the poles and employ their own operator. A large number of prominent farmers will have boxes in their residences.

The Philadelphia & Reading, Pa., Railway Company proposes establishing a telephone service along its main line to be used at points where there are no telegraph offices, such as sidings, etc. It has been decided that the telephone is a most valuable adjunct in the satisfactory operation of railroads.

P. L. Hensel, superintendent of the Central Union Telephone Company at Pekin, Ill., has resigned and has taken a position with an Independent company in Chicago.

The Home Telephone Company of Cassopolis, Mich., has filed articles of association with a capital stock of $25,000.

The Petersburg, Ill., Telephone Company, with a capital stock of 20,000, is in process of organization.

Clearing House for Independents to be Established.

A clearing house for the Independent companies of Nebraska is to be established. A favorable report was submitted by the committee to which was assigned the duty of meditating upon this proposition, and it was adopted by the telephone men. In co-operation with the executive board it will perfect a plan for a clearing house by which all the toll lines of the Independent companies may secure a just division of long-distance tolls. A report is to be made on this some time in March, to be carried to every board of directors in the Independent telephone business with recommendations for adoption. All who join, according to present plans, must sign a contract to belong for two years. On the committee are J. C. Killarney, Auburn; F. E. Ebersole, Lincoln; G. T. Everett, Columbus; W. E. Bell, York, and T. H. Pollock, Plattsmouth.

Telephone Society Formed.

The Telephone Society of Pittsburg, Pa., was lately organized by the employes of the Central District & Printing Telegraph Company, for the mutual advancement of its members. The officers were elected as follows. S. F. Grace, president: W. W. Read, vice-president, and W. W. Benton, secretary and treasurer. The executive committee consists of R. A. L. Snyder, G. K. Smith and W. H. Gallagher. S. P. Grace, chief engineer of the company, read a paper entitled "Aerial Cable, Distributing Systems."

The annual meeting of the stockholders of the Hamlin, N. Y., Telephone Company was held a short time ago. This company was incorporated by the business men and farmers of the town of Hamlin May 12, 1904, for the purpose of giving direct telephonic communication between the villages of Morton, Troutburg, Sunnyside Beach and intermediate territory located inside the town of Hamlin. Construction work was commenced at once and July 15 the exchange opened with 25 subscribers which had grown to 160 when cold weather set in. At the annual meeting it was voted unanimously to increase the capital stock from $5,000 to $10,000, which will be held entirely for subscribers of the company.

The Clifton Springs, N. Y., Telephone Company has been purchased by the Consolidated Telephone Company of Buffalo and the management has been vested with Fred S. Bronson of the Geneva Telephone Company. The Clifton Springs Exchange has at present about 100 'phones. The new owners will rebuild the entire system in Clifton Springs and place it on a thorough up-to-date basis.

J. C. Crowley, manager of the People's Telephone Company of Duluth, Minn., recently appeared before the council and stated that his company wished to raise some money on its plant, and proposed issuing $100,000 worth of bonds.

The Iowa Telephone Company is preparing to construct eight telephone lines out of Des Moines, commencing early in the spring.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Albion, Mich.—The council has granted a franchise to the Albion Electric Light Company for 30 years.

Brownsville, Tex.—The People's Ice & Manufacturing Company will erect an electric light plant for which a franchise was recently granted.

Buffalo, N. Y.—Commissioner of Public Works Ward will soon have to prepare and present to the board of aldermen estimates of what an electric lighting and power plant will cost this city.

Camden, Tenn.—Stock has been subscribed for putting in an electric light plant here.

Colorado Springs, Col.—The Nob Hill Improvement Society is considering the matter of lighting the residence district by electricity, the same to be extended from the city electric lighting system.

Flora, Ind.—The town board of trustees has granted a franchise to David E. Miller to construct an electric light plant,

Fort Valley, Ga.—The council has caused an election to be held February 24 to vote on the question of issuing bonds to the amount of $12,000, for the purpose of establishing an electric light plant, and an extension to the present waterworks system.

Gillett, Wis.—The proposition to issue bonds to the amount of $6,000 for the installing of an electric light plant was lately carried.

Iola, Wis.—J. G. Fromer will erect an electric lighting plant in this city.

Jackson, Mich.—W. A. Foote will erect a new electric light and power plant in this city to cost $100,000.

Lake City, Ia.—It is said that the Lake City electric light plant will be sold under the hammer.

Laurel, Miss.—The electric light plant and power plant of the Laurel Improvement Company was lately destroyed by fire to the extent of $14,000. The company will rebuild at once on a larger scale.

Leesburg, Va.—W. E. Crosen & Co., of this city, have applied to the city council of Manassas, for a franchise for the erection of a system of electric lights during a period of 15 years. The proposed plant will have a capacity of 750 standard 16 cp. lamps.

Manitowoc, Wis.—The city engineer has been directed to prepare estimates on the cost of an electric light plant.

Marcellus, Mich.—The electric light and water department of this city, will install a new engine and other apparatus for its municipal plant.

McKinney, Tex.—A new electric light plant will soon be established here. The issuance of bonds to the amount of $8,000 have been sold.

Metuchen, N. J.—The Public Service Corporation Company has another rival. This time it is the Metuchen Gas & Electric Light Company, which was organized here with a capital of $50,000.

Obion, Tenn.—The people of this place will soon hold an election to decide the question as to whether an electric light plant shall be established here.

Paris, Ky.—This city is considering the erection of an electric light plant, and James M. O'Brien, W. H. Weele and T. P. Woods have been appointed a committee to investigate the cost, etc.

Pryor Creek, I. T.—R. H. Berry, of Lincoln, Mo., is reported as organizing a company to establish an electric light and ice plant.

Royse City, Tex.—The Royse Milling & Light Company has been incorporated with a capital of $20,000, by J. E. Poynter and others, to operate an electric light plant and grist mill.

Savannah, Ga.—Keller Brothers will erect an electric light plant in this city.

Silver Creek, Neb.—A movement is on foot to establish a system of electric lights here with fair prospects of success

Sturgeon, Mo.—The board of aldermen has ordered a special election to be held February 6, to vote on bonding this city to install an electric light plant.

Springfield, O.—A new electric lighting plant with modern equipment is to be built here by the American Railways Company. C. L. S. Tingley is secretary.

Tennille, Ga.—The money for the purchase of bonds recently issued by this city has been received. The bonds were issued for the purpose of extending the waterworks system and installing an electric light plant.

STREET RAILWAYS.

Alma, Mich.—The Alma Sugar Company will build an electric road in Emerson and Lafayette Townships.

Ames, Ia.—Steps are being taken to build an electric line between here and the Iowa Agricultural College.

Delta, Col.—The board of county commissioners lately granted an electric road franchise to W. B. Stockham and Charles Pike. The road will consist of two lines, one of which will run from this city to the Grand Mesa Lakes via Eckert, Cedar Edge and the four coal banks on Surface Creek. The other branch goes from Delta to the Smith's Fork anthracite coal fields. The entire distance will be about 90 miles.

Ft. Wayne, Ind.—Dr. Greenwell, of Huntertown, has been granted a franchise for the erection of a trolley line in this city.

Gault, Ont.—Hon. Charles D. Haines, who has undertaken the building of the Hamilton, Ancaster & Brantford Railway, also intends to promote electric lines in Guelph and this place He has had a route laid out which overcomes the heavy grades and reduces the cost of construction.

Keyser, W. Va.—A franchise has been granted by the city council to the Keyser, Burlington & Petersburg Electric Car Company of this city.

Lima, O.—The Lima, Findlay & Toledo Railway, with headquarters in this city, has been formed to construct and operate an electric line from here to Findlay. Capital stock is $700,000. Frank Butler, E. Sanburn, N. S. Harris and others, are the directors.

Lincoln, Neb.—The business men of this city are planning to organize a company for building an electric line.

Milwaukee, Wis.—The electric line from this city to Racine and Kenosha will be rebuilt this spring.

Owego, N. Y.—An electric railway between here and Binghamton is now practically assured. It will be built during the coming summer.

Selinsgrove, Pa.—It is said the right is to be secured for a Pennsylvania trolley line from Lewistown to this place and thence to Sunbury by a bridge over the Susquehanna at Shamokin Dam.

Tekanah, Neb.—L. F. Wakeheld and C. C. Pierce, of Sioux City, Ia., have the contract to build an electric line from here to Decatur.

Versailles, Ky.—The city council has granted a franchise to Clifford B. Bebee, of Syracuse, N. Y., for the right of way through this city for an electric railway.

POWER PLANTS.

Bristol, Conn.—The New Departure Manufacturing Company contemplates the erection of a power plant, and will install a turbine engine.

Edwardsville, Ill.—The power plant of the Edwardsville Electric Light & Power Company has been purchased by the syndicate in control of the Illinois Central Traction Company's interurban road. New machinery will be installed and the plant improved.

Glenwood Springs, Col.—Work will shortly be commenced on the new power plant of the Colorado Irrigation & Power Company in the canon of the Grand River near this place. L. W. Beard is chief-engineer of the company.

Tlacotalpan, Mex.—The San Defonso Woolen Factory, located near here, has applied to the Mexican Government for a concession to establish an additional power plant for the operation of its factory.

BIDS WANTED.

Cleveland, O.—Sealed proposals will be received at the office of the board of education, Rose Building, this city, until 11 o'clock February 25, for the furnishing of electric power to the various public schools in the school district. Address Charles Orr, director of schools,

Glenwood, Ia.—Bids will be received for a power house for the School for Feeble Minded.

Greensboro, N. C.—The Cape Fear Manufacturing Company of this place will contract for a 100 hp. engine and a 125 hp. boiler.

Greenwood, Miss.—The board of supervisors of Le Flore County, Miss., will open bids March 6 for steam heating, plumbing and electric wiring of the court house, according to plans on file in this city at the office of C. W. Crockett, clerk.

San Francisco, Cal.—Sealed bids will be received in triplicate at the office of Capt. W. C. Wren, quartermaster, United States Army, constructing quartermaster, Phelan Building, this city, until February 13, for the construction, plumbing, electric wiring, etc., of 21 buildings at Point Bonita, Cal., in accordance with plans on file at the office of the depot quartermaster, Seattle, Wash., or Portland, Ore.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15¼@15⅜c.; casting, 14⅞@15c.

We are informed that the Massachusetts Electric Companies is prepared this year to meet all its financial requirements.

The New England Telephone & Telegraph Company has declared the regular quarterly dividend of 1½ per cent., payable February 15.

General Electric insiders claim that the company's net profits are estimated to be running now at the rate of about $1,000,000 a month.

Application has been made to the New York Stock Exchange to list $3,000,000 Western Union Telegraph Company refunding and real estate mortgage bonds of 1950.

The situation in the copper market remains unchanged. The market is extremely dull, but very firm. There is very little copper offered, and there is a correspondingly slack desire to buy.

Application has been made to the New York Stock Exchange to list $5,250,000 additional first refunding mortgage 4 per cent. bonds of 2002 of the Brooklyn Rapid Transit Company.

February dividend disbursements in New York are estimated at $31,697,164; interest, $23,444,688; total, $55,141,852, as compared with $61,734,200 in February, 1904, and $63,556,985 in February, 1903.

The directors of the Wagner Electric Manufacturing Company, St. Louis, voted a quarterly dividend of 1¾ per cent. It is expected that the business for 1905 will show a large increase over that secured in 1904.

The Iroquois Electric Company of Buffalo, N. Y., has been incorporated with a capital of $1,000,000 to manufacture electricity for light, heat and power purposes in the villages and towns in Erie and Niagara Counties.

It is expected that the Philadelphia Rapid Transit Company's earnings for the month of January will show an increase of over $100,000. Present earnings indicate that the gross for the year will not be far from $17,000,000.

The Havana Electric Railway Company has applied to the New York Stock Exchange to list $8,250,000 consolidated mortgage 5 per cent. 50-year gold bonds of 1952; $5,000,000 6 per cent. non-cumulative preferred stock, and $7,500,000 common stock.

It is understood that practically 80,000 shares of the Chicago City Railway stock have been deposited under the offer of the Morgan-Mitchell-Field syndicate of $200 a share provided a majority of the capital and the control of the property is turned in.

At the annual meeting of the stockholders of the Brooklyn Rapid Transit Compnay the four retiring directors were reelected. The stockholders also voted to confirm and approve all the acts of the directors of the executive committee for the past year.

Upon application of the Chicago Union Traction Company and the City Railway Company, Judge Grosscup, in the United States Circuit Court in Chicago on Monday, granted a temporary injunction restraining enforcement of the universal transfer ordinance recently adopted by the Chicago City Council. The ordinance, it is alleged, impairs a contract between the traction companies and the State, and therefore is in violation of the Federal constitution.

ELECTRICAL STOCK QUOTATIONS.

Name.	Closing price Jan. 30
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	170½
Metropolitan Street Railway	116
Metropolitan Securities	76¼
Ninth Avenue	197
Third Avenue	129⅞
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	60⅞
Interborough Rapid Transit	200¼
New Orleans Railway	3½
Public Service Corporation (New Jersey)	141
Philadelphia.	
Consolidated Traction of New Jersey	82½
Philadelphia Traction	100
Union Traction	59
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	15
do. do. do. pref.	60
West End Street, com	96
do. do. do. pref.	114
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	12¼
do. do. pref.	47½
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	16½
do. pref.	65½
Electric Boat, com	42
do. do. pref.	82
Electric Lead Reduction	½
Electric Vehicle, com	16
do. do. pref.	24½
Westinghouse, com	180½
do. pref.	192
General Electric	184½
Boston.	
Edison Electric Illuminating	251
General Electric	185½
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	156
National Carbon, com	41¼
do. do. pref.	114½
Philadelphia.	
Electric Company of America	10¾
Electric Storage Battery, com	78
do. do. do. pref.	78
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	145½
Western Telephone Company	18½
New England Telephone Company	139½
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210¼
Mexican Telephone Company	1⅝
New York & New Jersey Telephone Company	158¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92½
Chicago Telephone Company	141
MISCELLANEOUS STOCKS.	
Otis Elevator Company	49
Consolidated Car Heating	64
Standard Underground Cable	200

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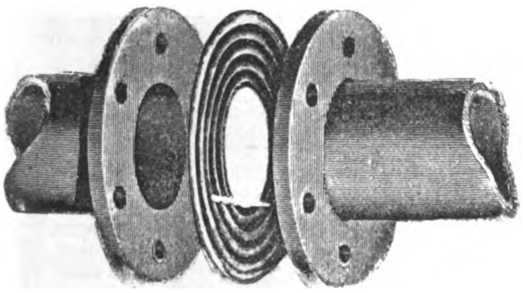

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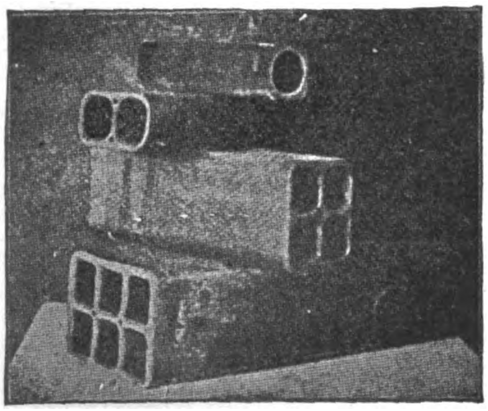

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EDITORIAL NOTES.

The Load Limit of Great Power Generators.

Large units, as they are called, have taken the place of many small units in power stations. The argument, as formerly advanced, was "use small units, so that in case of breakdown there will be enough generators in operation to continue the service." The danger of a breakdown at the time this idea prevailed, was greater in power plants than it is to-day. Breakdowns were due to the armature burning out, to hot bearings from a continuous high speed, or to the evil effects of lightning discharges. The difficulty of distributing the load fairly was one of the defects of early station design. The next difficulty was that of building generators to stand the wear and tear of continued strain. A great many lessons were learned from these early experiments in station construction and operation. One of the first was to build generators capable of standing a larger percentage of overload.

The next was a full comprehension of the necessity for building larger generators. And finally, the third important conclusion arrived at was, that a few large slow speed generators were in every way preferable to a series of small high speed machines. The large unit, in other words, predominated, and in consequence its construction was designed with reference to that very important factor, the factor of overload. The load limit of great power generators is such to-day that they will stand the heaviest strain without flinching. A 25 per cent. overload is not uncommon and cases have been recorded of a 50 per cent. overload for many hours. When we speak of overload we mean heat and sparking. By this is meant that a dynamo is a heat-developing machine. If it rises but little in temperature at full load, its capacity is naturally greater than a dynamo which heats up quickly under similar circumstances.

Holding the sparking in check as well as the temperature in giant generators of direct current construction is one of the triumphs of modern electrical engineering. The difference in the capacity of a 100 kw. dynamo, operating at the north pole and at the equator respectively, would be at least two to one.

The point of importance here is that a well-ventilated engine room means coolness, and a greater capacity in consequence of the generators in action. The latest design of power stations takes this fact into consideration for this and other reasons as well.

Large units with their slow speed and slowly rising temperature are thus the natural result of a chain of reasoning that is backed up by expensive experience. It is more through this success, perhaps, than anything else that electric lighting now rests upon a firmer technical and business basis. The most reliable machines in service to-day are unquestionably the heavy generators of our biggest stations engaged in supplying electricity for light and power.

* * *

Leave Well Enough Alone.

Last week a reader of the New York "Evening Journal" wrote and asked that paper for arguments in favor of municipal and Government ownership.

The answer appeared in the form of an editorial such as the "Journal" alone is capable of producing. It said: "Statistics on the matter are not lacking. In Germany, France, England, in New Zealand especially, Government and municipal ownership have been thoroughly tested. In every case practical results have justified and supported the theoretical idea of honesty and social common sense underlying the ownership of public monopolies by the people themselves."

It is true that statistics are not lacking, but the "Journal" takes particular pains not to give any.

In Germany, Russia and a few other countries the railroads are Government enterprises, and being operated under iron-clad rules, the employes subject to military discipline, they have proven fairly satisfactory to the inhabitants of the countries in which they are located. But the methods and the system in vogue in those countries would not be tolerated by the people of the United States. There is too much "red tape" and deliberateness, and it is this that has made them as successful as they are.

Furthermore, conditions and ways of life abroad are radically different from what they are in this country. In Germany, France, Russia and even England, men are content to get rich by the slow process of saving, whereas in the United States men accumulate wealth not so much by saving as by reaching out and grasping. And, sad to relate, a great many are not particular how they reach and grasp.

The Post Office is a Government enterprise and is supposed to be run for the benefit of the people, yet a recent investigation disclosed, to say the least, a very unsatisfactory condition of affairs. The Police Department in this city is a municipal enterprise, supported by the people and supposed to be for the people, and yet when men and women are held up on the street and robbed in broad daylight, and members of the force get independently rich in a few years on salaries ranging from $3,000 to $5,000 a year, there must certainly be something wrong with this municipal undertaking.

One of the arguments advocated by the "Evening Journal" in discussing Government ownership is as follows:

"I know that railroads well managed in the interests of the public would mean increased happiness for all of the people. I know that the railroads, managed by private, selfish interests, are used against a majority of the people and to promote the interests of a selfish few."

The gist of the whole argument, if argument it can be called, lies in the two words "well managed." Would the railroads of this country or any other great undertaking be well managed by politicians and hangers-on, with changes taking place every four or eight years through the incoming of a new administration?

President Roosevelt says: "We can as little afford to tolerate a dishonest man in public service as a coward in the army," and yet scores of dishonest men creep into politics, and they are the ones that would cause through avaricious motives municipal and Government enterprises to be a failure.

* * *

How the Telephone Trust Makes Money.

A bill has been introduced into both branches of the New York Legislature with a view to controlling telephone monopoly as far as it exists in this city.

The bill in question provides for the amendment of the transportation corporations law so as to provide that telephone companies may not charge their regular subscribers toll or additional compensation for any message sent through its instruments or over its wires to any place within any of the separate boroughs of the City of New York and which does not take more than five minutes to send; and no greater charge than ten cents shall be made for the use of a public telephone for the transmission of a like message not exceeding five minutes to send, nor more that ten cents for each additional five minutes to send within any of the separate boroughs of the City of New York.

Referring to the subject Senator Keenan, who is one of the minority members of the Senate Finance Committee, before which are now pending the joint resolutions for legislative inquiry into the Gas and Electrical Trusts, is reported as saying:

"The Gas Trust is a pigmy compared with the Telephone Trust. It is an outrage that all sorts of prices are charged for interborough telephone messages. A three-minute message between Queens and the Bronx now costs 35 cents. Until recently it cost 40 cents, even between points both lying in Queens County. Between Newtown and Flushing a call costs 15 cents, although a five-cent carfare prevails. Rates at present from various boroughs of the consolidated city are all the way from 20 cents up. No other city in America has to pay such exorbitant charges. The earnings of the companies comprising the trust are enormous and they certainly warrant a reduction of the tolls. Ten cents a message within any part of New York City ought to be enough."

Not many miles from New York across the Hudson River are two towns situated about two miles apart. A telephone exchange belonging to the New York and New Jersey Telephone Company is located in the larger of these towns and less than a score of private telephones in the smaller. The telephone charge is $2 a month for a four-party line which entitles a subscriber in the smaller town where there are practically no 'phones to call up any one that has a 'phone as often as he pleases. Whenever a connection is wanted the central in the larger town has to be rung up. Now comes the point. The object in having a 'phone put in by residents of the smaller place is to enable them to call up their tradesmen or friends in the larger town, and until very recently each such call cost the smaller town subscriber just 15 cents extra per message.

These prices prevailed for several years in spite of remonstrances and kicks on the part of the small town subscribers. For some, no doubt charitable, reason the monopoly saw fit a few months ago to send out notices that if the small town subscribers would make new contracts the heretofore 15-cent call would thereafter be reduced to 10 cents—which is still an imposition.

Several Senators are reported from Albany as saying that what is wanted to get through a bill regulating telephone rates is facts. Let, therefore, some recognized body of business men in this city get together with a view to forcing an inquiry and procure the necessary *facts*. They should not be so hard to get.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

We will pay 25 cents for a copy of ELECTRICITY of October 19, 1904.

◆

The annual dinner of the American Institute of Electrical Engineers will be given to-night (Wednesday) in the grand ball-room of the Waldorf Astoria. There will be a number of interesting speakers and an original menu has been prepared appropriate to the occasion.

◆

Mr. H. H. Vreeland, president of the New York City Railway Company, will deliver an address before the New York Electrical Society February 15 on the development of street railway systems.

◆

A cable dispatch from Paris says that an important discovery of a radium mine in the Department of Saone-et-Loire is interesting scientific circles. Prof. Curie's assistant is conducting the exploitation.

◆

While discussing the subject of the electrification of steam railroads Senator Chauncey M. Depew made this prediction:

"In ten years from now the steam locomotive will be in the museums, while we will be carried along, clipping the seconds off 75 miles an hour, by electric locomotives."

On January 24, Judge Kohlsaat in Chicago granted a preliminary injunction in the case of the Weston Electrical Instrument Company against the Jewell Electrical Instrument Company. Mr. William Kenyon, of the firm of Kenyon & Kenyon of this city, and Mr. C. A. Brown of Chicago were counsel for the complainants. Mr. Edward Weston was present at the hearing.

The committee of arrangements of the International Association of Municipal Electricians will meet at Erie, Pa., February 13, to make arrangements for the next convention.

The "Lancet" of London has made the discovery that there is 100,000,000,000 tons of gold in solution in the oceans of the world and that steamers might be able to collect a reasonable quantity by suspending in the sea copper plates connected with dynamos. At the end of a voyage the plates could be examined for gold, says the "Lancet," and some idea of the practicability of recovering the metal would be gained. This is the first time the question of extracting gold from the sea has been brought up since the Rev. P. F. Jernegan's Electrolytic Marine Salts Company's bubble burst with such disastrous effect in 1898.

In spite of the prolonged agitation on the subject, only five municipalities in Great Britain have established telephone plants, and 41, after investigation, have decided not to do so.

An English dentist is reported as having invented a sleeping bunk for steamers which will remain level in any sea. The cot is suspended in a steel frame-work from the roof of one of the deck cabins, and the motion of the boat is counteracted by four cords from each corner which passes through electric brakes. These automatically maintain the cot in a horizontal position. The berth is also fitted with a water mattress and has an electric fan, which can be set in motion by touching a button and drives a delicious draught of air across the face of the occupant.

The annual meeting of the American Electrochemical Society will be held in Boston and Cambridge, Mass., April 26 to 27. Among those who will contribute papers are Messrs. Carhart, Blake, Reuterdahl, Richards, Bancroft, Noyes and C. Gordon Richardson. The headquarters will be at Hotel Lenox.

The Secretary of the Treasury has asked Congress to make an appropriation of $60,000 to enable him to install and maintain electric burglar-alarm devices in connection with vaults and safes in buildings under the control of the Treasury Department during the fiscal year ending June 30, 1906. This appropriation will provide for protection additional to and separate from that authorized by the sundry civil act of March 3, 1903.

Mr. William H. Blood, Jr., has the chairmanship of the committee on district heating for the National Electric Light Association, and expects to present a very full and important report on this branch of central station industry. The other members of this committee are Mr. C. R. Maunsell, of Topeka, Kan., and Mr. R. S. Wallace, of Peoria, Ill., both of whom have had personal experience with steam and hot-water heating plants, as well as having given the subject extensive study and observation. A liberal appropriation has been made by the association for carrying on investigations.

THE GREAT PROBLEM OF MUNICIPAL LIGHTING PLANTS IN LARGE CITIES.

The question of what is a city's business can be answered in various ways. To some, it is anything which concerns the public; to others, it is only the routine of city life. There are times when certain matters which relate to questions of municipal economy arise; they are seized hold of by the public, and as if by magic an argumentative epidemic rages. Such occasions are not infrequent, owing to the uniqueness of American institutions in this respect. The newspapers and the public keep their eyes riveted on all transactions relating to the present or future welfare of the community. As a result of this a consensus of opinion prevails which often emanates from those wholly unprepared by training or experience to arrive at such conclusions. There are times when a majority is not right because it represents a preponderance of opinion. In fact, it is so frequently the opposite, that in New York and other large cities in the United States, when public opinion has ruled for one thing, it is not uncommon for it to rule the other way in a very short time. When public opinion, however, is guided by a healthy newspaper influence to the correct conclusions, then the progress of American commonwealths is being assisted to its proper goal.

One of the great questions at present occupying the time and attention of the two leading cities in this country is that of the advisability of erecting its own electric light plants, generating its own current and thus supplying its public buildings and thoroughfares with cheap and efficient illumination. Of these two cities, Chicago and New York, Chicago claims to have arrived at a successful solution of this problem. New York, standing at the threshold as it were, is about to establish as its first experiment in this direction a 400 hp. plant to be located under Williamsburg Bridge.

There are pros and cons to the question of municipal ownership that have agitated the minds of some of the greatest thinkers of the day. If there is any intention which is remote from those which represent the fundamental ideas of American institutions, it is that of having municipalities engage in competition with private institutions in any department of commerce or industry. When such causes arise, as would invite such action, the remedy is legislation. No more dignified or just method could be conceived and none more effective in cases of exorbitant charges. In either case this would seem to be the natural outcome. If a city enters into a certain industrial field, its possession of facts and figures if successful in its enterprise would force it to legislate against overcharge on the part of those supplying some great public commodity. When this happens, the original cause of so radical a move on the part of the city disappears. Low rates would then make a city plant a useless encumbrance.

The "Brooklyn Eagle" publishes a report received from Mayor Carter Harrison, of Chicago, outlining the financial history of that city's experience in the field of municipal ownership.

Judging from the statements made by the Mayor, Chicago is making money on her plant. He claims an earning power of a quarter of a million dollars a year through its operation, and contemplates extensions which represent the flotation of $200,000 worth of city bonds the present year. The statistics supplied give detailed figures from 1898 to 1903 inclusive, although the plant was initiated in 1887. At this time it was under the management or jurisdiction of the Fire Department. In 1898 a separate department of electricity was founded, and at its head was placed Edward B. Ellicott, formerly of the Westinghouse Company. Under his management the Mayor claims a successful demonstration of the advantage of municipal ownership was made in a technical and financial sense. In the following table, the money expended for the construction and operation of Chicago's electric light plants from 1887 to 1903 is given for each consecutive year:

TABLES OF EXPENDITURES FOR BUILDING AND OPERATING MUNICIPAL ELECTRIC LIGHT PLANTS.

Expended for Construction and Operation.

1887....Expended for construction.........	$39,976.25
1888....Expended for construction and operation	90,952.90
1889....Expended for construction and operation	331,616.62
1890....Expended for construction and operation	214,330.60
1891....Expended for construction and operation	214,951.98
1892....Expended for construction and operation	134,674.16
1893....Expended for construction and operation	168,169.21
1894....Expended for construction and operation	174,143.15
1895....Expended for construction and operation	180,330.08
1896....Expended for construction and operation	144,077.56
1897....Expended for construction and operation	152,493.00
1898....Expended for construction and operation	289,483.39
1899....Expended for construction and operation	347,377.14
1900....Expended for construction and operation	433,524.08
1901....Expended for construction and operation	340,205.45
1902....Expended for construction and operation	274,357.48
1903....Expended for construction and operation	319,436.35
Total	$3,850,099.40
Less one plant sold in 1893 and transfer of real estate...........................	130,000.00
Total amount expended on account of plants..	$3,720,099.40

The sums range from about $40,000 in 1887 to over $319,000 in 1903. This covers the cost of from 200 lights in 1888 to about 5,000 lights in 1903. In 1893 the lighting system of Chicago was represented by a series of plants called plant No. 1, plant No. 4, plant No. 6 and plant No. 8. In 1899 it was represented by plant No. 1, the R. A. Waller plant, plant No. 6 and No. 8. In 1900 it consisted of plant No. 1, the R. A. Waller plant, plant No. 4, plant No. 6 and plant No. 8. In 1900 the same plants were in use. In 1901 plant No. 4 was not in use. In 1902 only the R. A. Waller, No. 6 and No. 8 plants were in use, and in 1903 the last three plants were performing the entire service for the city. It can hardly be said that these plants are very much up-to-date, nor do they represent the investment which would be required to equip a thoroughly modern plant with all the essentials of a large and elaborate service. For the purpose of establishing a basis of comparison the following table is presented which shows the estimated cost of an equal amount of lighting to that done by the city plant during the current years. The rates then prevailing are given and the amounts thus calculated. According to these figures, 1903, the last year given, shows an estimated cost at the prevailing rates of about $560,000 as compared with the actual cost of $319,436, a difference of over $250,000:

TABLE OF AMOUNTS RENTED ELECTRIC LIGHTS WOULD HAVE COST FOR CORRESPONDING PERIOD.

Number of lights operated by city and cost of same, if rented:

1888....192 lights if rented would have cost at $200.00.........................	$38,400.00
1889....297 lights if rented would have cost, at $185.00.........................	54,945.00
1890....900 lights if rented would have cost, at $175.00.........................	157,500.00
1891....993 lights if rented would have cost, at $175.00.........................	173,775.00
1892....1,102 lights if rented would have cost, at $175.00.................	192,850.00
1893....1,112 lights if rented would have cost, at $156.25.................	173,750.00
1894....1,108 lights if rented would have cost, at $137.50.................	152,350.00
1895....1,116 lights if rented would have cost, at $137.50.................	153,450.00
1896....1,254 lights if rented would have cost, at $137.50.................	172,425.00
1897....1,438 lights if rented would have cost, at $137.50.................	197,725.00
1898....1,710 lights if rented would have cost: 272 at $105.00, and 1,438 at $137.50	226,285.00
1899....2,893 lights if rented would have cost: 1,297 at $105.00, and 1,596 at $137.50.........................	355,635.00
1900....3,867 lights if rented would have cost: 2,136 at $103.00, and 1,731 at $137.50.........................	458,020.50
1901....4,305 lights if rented would have cost: 2,551 at $103.00, and 1,754 at $137.50.........................	503,928.00
1902....4,508 lights if rented would have cost: 2,754 at $103.00, and 1,754 at $137.50	524,837.00
1903....4,827 lights if rented would have cost: 3,008 at $103.00, and 1,819 at $137.50.........................	559,936.50
Total amount rented lights would have cost...	3,895,812.00

A very interesting situation now presents itself, when the total cost of the series of municipal plants dating back from 1887 to 1903 is compared with the total hypothetical outlay at the then prevailing rates during the same period of time.

Under the head of the amounts that *would* have been spent for electric lighting from 1888 to 1903 is found a total for all those years of $3,895,812. Under the head of expenditure for building and operating the plants for an equal period and for the supplying of an equal number of lights is found a sum total of $3,720,099. These two sums are the foundation for interesting conclusions according to these records. They are very nearly equal to each other, considering the magnitude of the totals. The difference is $175,713 for a period of 16 years.

In other words, according to these statistics, **the money that would have been spent by Chicago for electric lighting is the money that paid for the construction and operation of its electric lighting system.** The year 1903 cost the city over a quarter of a million dollars for about 5,000 arc lamps. According to the rates quoted, the Mayor claims a saving of nearly $300,000 as shown by the following figures:

1903.

Cost of rented service, 4,827 lamps.........	$559,936.50
Cost of operation (less taxes)...............	262,888.38
Earning power..............................	$297,048.12

The proposition, from this point of view, shows that equal lighting would have cost about $300,000 more by private companies than it actually cost the city.

To quote Mayor Harrison: "The saving to the city may be more clearly understood when it is considered that in order to have the same lighting service from rented sources the appropriation bill will have to be increased $297,048.12 for the year 1903, and the revenue to the city would only be increased by 21 per cent. of what taxes might be paid by a private corporation owning and operating the system, the balance, or 78 per cent. of taxes, being assessed for other than municipal purposes."

Perhaps the taxes that would be paid in comparison with the dollars and cents saving to the city in electric light bills are small, but how about the effect of a change of rates when the private corporations have managed to clean off their indebtedness to some extent for improvements and extensions.

The danger in all such estimates is due to the basing of the need for a municipal plant upon the idea of the fixity of the rates. Let the rates fall and the tax question assumes greater importance as would the value of a municipal plant necessarily assume less.

Chicago's apparent success in this field is no guarantee of an equal success, if it may be so-called, in New York. Here the conditions are different. All wires must go underground and all lamps must burn with brightness and equality. The expense of lighting in New York is necessarily greater than that of any other city in the world. It is, on the other hand, the most perfect and the most successful. If the expense of putting all wires underground as required by the municipalty in New York were added to Mayor Harrisons figures and in addition the same high grade of lighting were done as the city streets now receive, the above figures would undergo changes to a remarkable degree.

Mayor McClellan expects in about three months to close the switch which will send the current from New York's first electric light plant to the arc lamps of Williamsburg Bridge and the adjoining school-houses in the neighborhood.

THE ELECTRICAL EQUIPMENT OF A LONDON HOSPITAL.*

While it must be admitted that medical electricity as a whole is less advanced in this country than abroad—mainly through the abuses practised in its name by quacks in the earlier days—there is no doubt that great progress has been made during the past few years. The British Electro-Therapeutic Society was formed three years ago and now numbers over 160 members. Most of the great hospitals have instituted departments for the treatment of diseases by electrical means.

The latest of these is that of Guy's Hospital, St. Thomas Street, S. E. Here a complete installation of apparatus has been laid down, for almost every description of electrical treatment now in vogue. We give herewith a brief account of the various systems installed, with illustrations of the apparatus.

No installation would be complete without the Finsen light apparatus for the treatment of lupus, which has been the means of effecting countless cures of that repulsive disease since its introduction but a few years ago by Dr. Finsen—now, alas, no longer with us.

Numerous improvements have been made in the construction of the apparatus all of which are embodied in the one here illustrated. Suspended from a strong support is an arc lamp of extremely high candle power, around which is suspended a heavy metal cylinder, serving to carry the telescopes and the necessary pipes and taps for the water-cooling of the telescopes and compressors, through which the rays pass before reaching the patient. The telescopes are constructed of brass barrel, with rock crystal lenses to concentrate the rays of the arc lamp. At the end of each telescope nearest the lamp a space is left between two of the lenses which is filled with distilled water; around this a water jacket is fitted to permit of the circulation of running water from the main supply in order to keep it cool. The distilled water fulfills the double purpose of eliminating some of the heat rays and of preventing the top lens from cracking, owing to its exposure to the great heat from the arc lamp. At the other end of the telescope for a space of about 12 inches, between two more lenses, is a column of distilled water which absorbs further heat rays. Around the four telescopes are arranged couches on which the patients lie whilst under treatment. The part to be treated is brought to the point of convergence of the rays through the telescope and compressors consisting of rock crystal lenses, between which a stream of water is continually circulating, are pressed firmly on the skin, in order to render it anæmic, as the presence of red fluid would prevent the ultra-violet rays from properly penetrating. Here occurs the final exclusion of the heat rays, and the chemical rays alone reach the patient. By an ingenious arrangement, the fullest use is made of the light from the lamp, so that the current consumption is about 50 amperes only, as against 70 or 80, or even more, in the older types.

The main features of the Finsen-Reyn lamp for lupus treatment of a single patient are very similar to the foregoing, there being an arc lamp of very high candle power arranged to project its rays through a telescope for the elimination of the heat rays and the concentration of the chemical rays to a point where a compressor is used on the patient, as with the large Finsen apparatus. A special type of self-feeding arc lamp is used with this instrument which has proved very satisfactory in working. The stand on which the apparatus is mounted is designed to give every possible movement and height required, and it is mounted on a wheeled base.

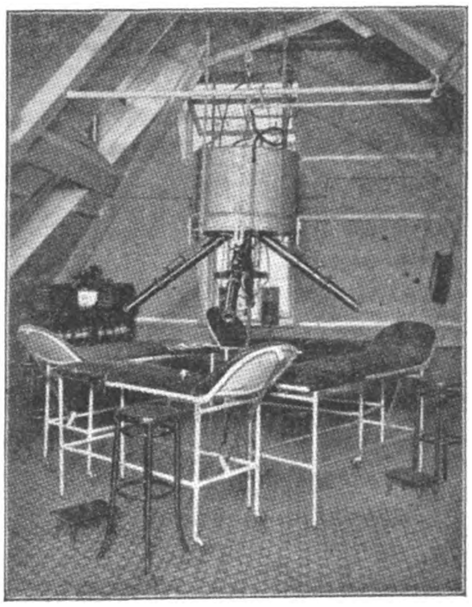

FIG. 1.
Finsen Light Apparatus.

Next follows an extremely useful lamp, also designed for the light treatment of lupus; this is a modification by the London Hospital staff of the French lamp, Lortet-Yenoud. The general construction consists of a stand having a heavily weighted base, on which is mounted a hand-feed arc lamp. The rays from this lamp are projected through a double shield having two rock crystal lenses set in its center; between these circulate water from the main supply, serving the same purpose as in the apparatus already mentioned. In the use of this lamp no compressor is required, as the part to be treated is pressed against the front lens of the shield. All the above light converging apparatus are also being successfully employed in the treatment of rodent ulcer.

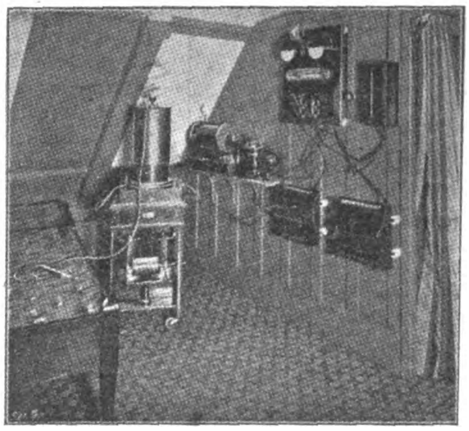

FIG. 2.
High Frequency Apparatus.

Fig. 2 illustrates a cubicle fitted for the application of currents of high pressure and high frequency, which have been used with great success in rheumatism, arthritis, anæmia, neurasthenic conditions, pruritus ani, and certain stages of pulmonary tuberculosis.

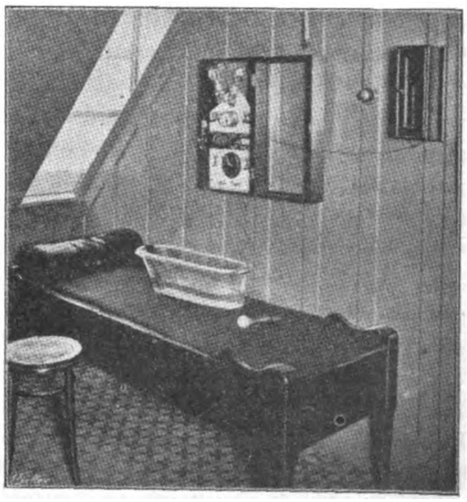

FIG. 3.
Switchboard for Galvanism, Faradism and Electrolysis.

In this installation the direct current from the main supply is utilized both for the induction coil and to actuate the motor of the mercury jet interrupter, through variable resistances; a switchboard is used in connection with them for controlling the current, having mounted on it a voltmeter and ammeter for reading the pressure and current supplied to the primary coil. From the secondary coil, which terminates at the discharging pillars, wires are led to a spark gap and Leyden jars where extremely rapid alternations of current are set up. The high frequency current passes to a solenoid composed of windings of thick copper wire, of which, by means of an ingenious arrangement, more or less can be inserted, controlling thereby the pressure which is utilized in the treatment. The current is applied through vacuum tubes, where local treatment is desired, and by the condensation method when the general electrification of the subject is considered necessary. Various other methods of treatment are also used which need not here be described.

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*From the "Electrical Review," London.

The peculiarity of this system is that enormous voltages and quite a heavy current can be used without danger to those under treatment. The processes of metabolism seem to be those principally affected by high-frequency currents.

The next illustration, Fig. 3, shows a switchboard for galvanism, Faradism, combined current, and electrolysis. It consists of a polished marble base, whereon are mounted two resistance lamps with switches, a galvanometer with a shunt to increase the range of the instrument, a switch to reverse the polarity of the galvanic current, switch to allow a galvanic, Faradic, or combined current to flow from the terminals, Faradic coil with regulating primary and secondary, and a special circular wire rheostat of 10,000 ohms resistance, divided into 56 steps, this allowing of very fine gradations of current. Great success has attended the application of these currents, in conjunction with a special arm bath, for writer's cramp. In rheumatism, paralysis, neuralgia, etc., the treatment has also been found most efficient.

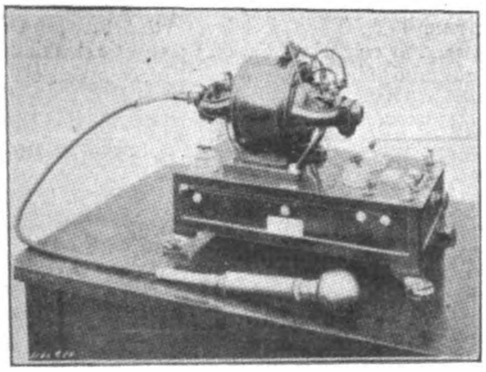


Fig. 4.
Apparatus for Vibratory Massage.

Fig. 4 shows an ingenious and useful motor transformer, wound to run on the 105-volt direct current mains. Attached to one end of the shaft is a flexible cable with a ball attachment at its extremity; this ball vibrates with various degrees of amplitude, regulated by a collar arrangement, which can be moved round while the ball is in action on the patient; the top of the ball is drilled with three screw holes to take variously shaped electrodes for the local treatment of the smaller muscles, etc., where the ball itself would be too large. This form of massage treatment is now very largely employed in many cases where formerly manual methods were used, and it has been found that the results are much better, as the form of vibration is immeasurably superior to that which may be gained by any other means. Other advantages of the motor transformer are that it can be used to give a regulated sinusoidal current to light small lamps such as head-lamps, laryngoscopes, cystoscopes, etc., and also to render a cautery point incandescent.

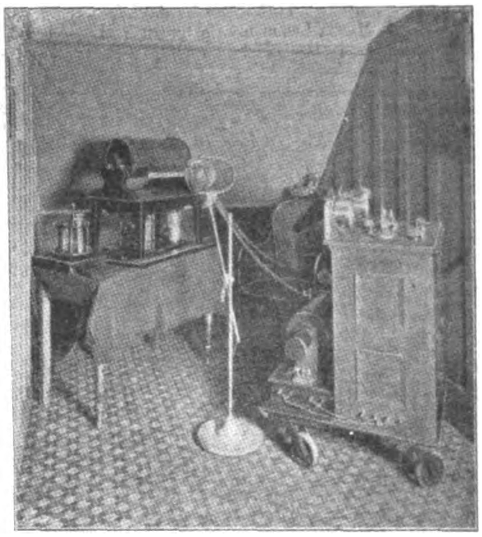


Fig. 5.
High Frequency and Roentgen Ray Apparatus.

In Fig. 5 is shown a cubicle fitted for high frequency currents and Roentgen rays for therapeutic purposes. We have already spoken of the high frequency treatment, and will now briefly describe the X-ray arrangements. The induction coil utilized is of 12-in. spark length, with a dipper type mercury interrupter. The current utilized is a direct current from the main, through regulating resistances, for the coil and motor of the interrupter respectively, volt and ammeters being in circuit to read the pressure and current used. There is a special feature about the arrangement of the X-ray tube itself for therapeutic treatment; the tube is mounted on a stand, and is inclosed in a transparent screen which entirely cuts off the rays from both patient and operator, a most important desideratum. To permit the passage of the rays to the part of the patient to be treated, there is an orifice in the globular screen, to which can be fitted various tubes of the same material; through these the rays pass directly to the affected part only, thus dispensing with the use of lead-foil protection, which was formerly necessary to prevent burns. The tubes can be sterilized, and the arrangement presents other features of great value. The therapeutic value of the Roentgen rays is already well known, so that it is unnecessary to mention specifically the various forms of disease on which they exercise curative effects.

The whole of the apparatus herein described is housed on the top floor of one of the hospital buildings, which has been set apart wholly for this purpose. The circuits to the various cubicles are controlled by a large main switchboard, and connected with the main circuit of the hospital. We recently availed ourselves of an opportunity of inspecting the whole installation, and were exceedingly pleased to find how complete were the arrangements for applying the curative properties of electricity for the alleviation of so many of the diseases of suffering humanity.

ELECTRICITY LEAFLETS.

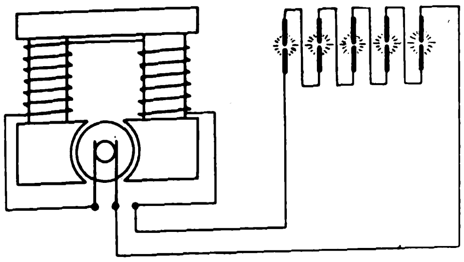
BY NEWTON HARRISON, E. E.

Electric Lighting.

Electric lighting has progressed with wonderful rapidity in the last decade. Totally distinct systems have become merged into one and currents which are either alternating or direct are transformed into each other without difficulty. Electric lighting proper and power transmission have become stepping stones to each other, so that the greatest operating systems found in New York and other of the largest cities in the United States embody these two ideas—a combination of high pressure alternating with low pressure direct—in the present equipment of electric light stations.

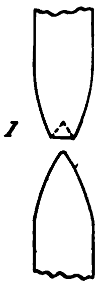
Kinds of Electric Lighting.—Electric lighting is done by means of alternating and direct currents. If the alternating current is solely employed for this purpose the machinery used includes alternators and transformers, the essential elements of this system. If direct current is used for electric lighting, the character of the current varies according to the nature of the lighting or lamps employed. Under the head of direct current lighting may be found: Lighting by means of a constant current, and lighting by means of a constant potential.

Dynamos suitable for the generation of such currents are also termed "constant current and constant potential dynamos." Constant current dynamos are designed for the purpose of supplying energy to arc lamps; constant potential dynamos for the purpose of supplying energy to incandescent lamps. A constant current dynamo is series wound, and in consequence the current developed in the armature passes through the outside series circuit, the field windings, back again to the armature. The illustration clearly shows the simple character of the system.

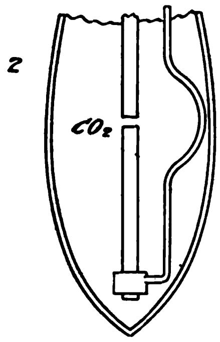


Series Wound Dynamo and Arc Lamps in Series.

In a series system of electric lighting each arc lamp requires a certain current and pressure or it will not give the candle power expected. The old type of arc lamp consumed 10 amperes and 50 volts; the new type with closed globe takes 80 volts and about 12 amperes. One lamp is built with its carbons burning in the air the other and more improved type has them inclosed in a small globe supplied with a valve. When the oxygen in the air is consumed only an innocuous gas remains. The result is no further oxidation of the carbons and an increase in their period of usefulness of from 8 or 10 hours in the older design to from 100 to 150 hours in the most improved design. The increase in power required through the introduction of this later device is well counterbalanced in a financial sense by the saving in labor in renovating the carbons, by the saving in carbons themselves and by the greater safety and convenience their use entails. These lamps are used on both the constant current, constant potential and alternating current systems.



Carbon lasts 10 hours in air.

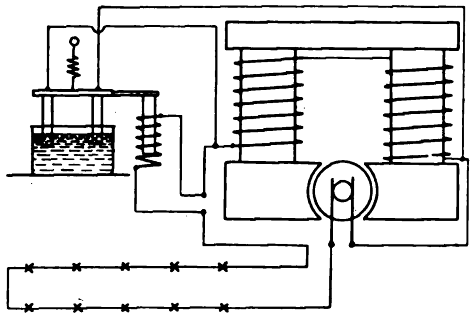


Carbon lasts 150 hours in a globe.

Constant Current Regulation.—Regulations by means of a series dynamo connected to a series circuit calls for a method by which the dynamo is capable of automatically increasing or decreasing its difference of potential as the number of lamps are increased or decreased in its circuit. If, for instance, 20 lamps of the older type were employed, each lamp requiring 50 volts and 10 amperes, a current of 10 amperes and 1,000 volts must be sustained. This is not all, however; the dynamo is furthermore required to automatically regulate its voltage and current if one-half or one-quarter of the lamps are cut off. This means that if 10 lamps are on the circuit 500 volts only are needed, 15 lamps, 750 volts, etc., and under all these circumstances of change the 10 amperes remain constant. The problem is that of a circuit in which, with every increase of resistance, an increase of voltage must take place. The accomplishment of this is due to a very interesting study of the conditions which prevail in a dynamo. The means to be employed for the regulation of the voltage of a dynamo can be included under the following heads: Increasing or decreasing the speed, increasing or decreasing the lines of force, and increasing or decreasing the armature conductors.

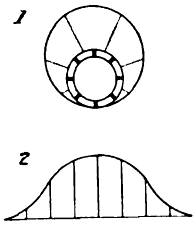
It is quite evident from a review of the possibilities presented here that it is not practical to attempt to change the speed to suit each particular voltage. The other two methods have been successfully carried out; that of varying the magnetic field by means of a resistance placed across the terminals of the field winding, so controlled in an automatic sense that when more volts were required this resistance was increased and when less volts were required it was cut down; and a utilization of more or less of the armature conductors as more or less lamps were thrown into circuit.

Shunting the Field.—The reasoning employed to utilize the changes in field strength is as follows: If more volts are required of the dynamo, more volts can be generated if more lines of force are supplied to the rotating conductors. The reverse is also true when less volts are required, due to the number of arc lamps being diminished. If an electro-magnet is placed in series with the outside circuit, a temporary increase or diminution of current caused for an instant by the lamps being increased or decreased in number, will make the coil a stronger or weaker electro-magnet. If the coil attracts a core of soft iron, which is attached by the proper mechanism to a pair of carbons dipping into water, then if the mechanism operates in such a manner that when the magnet is strengthened the carbons dip deeper and when the magnet is weaker the carbons are lifted out, the object is accomplished of weakening the field strength by shunting the fields when the pressure is too high outside, and increasing the field strength by lifting the carbons out when the outside pressure is too low. Tracing the circuits will show that the carbon rods dipping into the water offer a resistance which is greater or less across the field terminals according to the strength of the current in the main circuit. When the carbons dip deeply, current from the field passes through in such strength that the ampere turns are cut down and less volts are generated. When the carbons are lifted, less current passes through this liquid rheostat and more in the fields. In other words, this represents an adjustable resistance, adjusted in a shunt of greater or less resistance by the dynamo current, and this current itself temporarily varying through the effect of changes in the number of lamps of the circuit. To sum up, if the voltage supplied to a series of arc lamps is so elastic that more lamps means more volts and less lamps less volts, then as the increase or decrease of lamps mean the increase or decrease of ohms, the result would be a current of practically uniform strength. This, in fact, was the case with generators of this description, but the difficulty of adjusting the carbon rods and the resistance of the solution combined with a certain lack of responsiveness in the electro-magnet was the means of causing the general adoption of the last method of regulation by shifting the dynamo brushes.

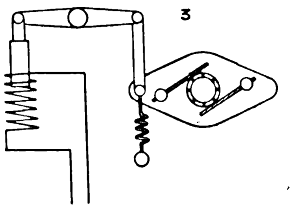


Regulating the Field Strength Automatically.

In reality, the conductors of an armature can only give out their full EMF. if the brushes are so situated on the commutator that their EMF. can be collected. There are points on the commutator where a pair of brushes can collect the maximum and minimum pressure. This is readily discovered in an ordinary shunt dynamo where the shifting of the brushes to different parts of the commutator increases or lowers the pressure a great many volts. Examination of the armature winding discloses the fact that the commutator is so connected to its conductor that the brushes can take off the pressure at a point where the EMF. is low as well as at a point where it is high. In fact, between points 90 degs. apart from each other, the commutator can give the highest and lowest pressure of the armature. The practical effect of this really is to increase or decrease the EMF. producing wires of the armature, at will. This cutting down or raising up of the armature difference of potential can be done by moving the rocker arm of the dynamo to which the brushes are attached either by hand or automatically. In arc light practice it is accomplished automatically by means of an electro-magnet connected to the main circuit. The current passing through the string of arc lamps actuates this coil and also a core which it energizes. The core is so arranged that it moves the rocker arm of the dynamo as the pull exercised upon it by the electro-magnet is greater or less. If the current in the magnet is very great the rocker arm is pulled over quite a distance, and in consequence the brushes take the pressure from different points of the commutator. When the magnet is not pulling very hard the current in the main circuit is normal, that is to say, an adjustment has taken place between the resistance represented by the arc lamps and the voltage supplied to the line by the dynamo. This continuous adjustment is only brought about effectually by means of an electro-magnet sensitive to a rise or fall of the normal current and its consequent reaction upon the position of the brushes through the medium of the rocker arm.



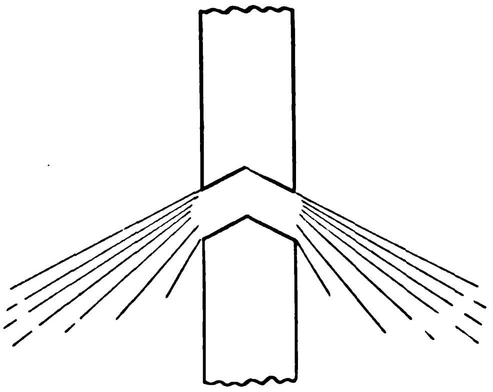
1 and 2—Distribution of Potential around a Commutator.



3—Shifting of Brushes by an Electro-magnet.

The preservation of a constant current in arc light circuits is only carried out if they represent the series high tension system. Here the voltage, as already shown, is calculated with reference to the number of lamps in operation, but arc lamps are constructed to work on low potential circuits as well by certain changes in their mechanism. In this case the preservation of a constant potential is necessary and the lamps are constructed and adjusted to suit the conditions.

Pressures as high as 6,000 volts have been used in high tension direct current lighting. The character of the current is pulsating, the throb or pulsation being very effective in keeping the high tension arc lamp mechanism in good adjustment. The candle power of arc lamps may be rated as either spherical or horizontal. The spherical candle power is the amount of light distributed on all sides of the arc. Light measured on a horizontal plane is the effective candle power produced. Means are employed to reflect as much of the candle power as possible downward and thus increase the effectiveness of the lamp as a source of illumination. In arc lamps used on alternating current circuits a reflector is absolutely necessary on account of the constant reversal of the arc. During one alternation the crater of the carbon is above, during the next below. The result of this is the continuous shifting of the light upward and downward and hence the necessity for a reflecting device of some description to preserve a uniformity in the degree of horizontal illumination.



Natural Reflector formed by the Crater in the Upper Carbon.

Constant Current Motors.—In those instances where other sources of electrical power are not available constant current motors are employed on high potential circuits. These motors are series wound and are regulated by means of their fields. The tendency of a series motor is to increase in speed if the load is reduced or the pressure increased. The regulation of this machine is accomplished by means of a governor, the action of which is to move a conducting piece along an insulating rod to which are attached one end of a series of coils composing the field winding. The field winding is divided up into a number of smaller coils which can be thrown in or out of circuit by the movement of the connecting piece actuated by the governor. If the speed of the motor tends to increase the governor by its action reduces the power of the machine by weakening the field. The operation of this device has nothing to do with the preservation of a constant current. That is attended to by the arc light generator and the current in the motor therefore remains the same.

The increase or decrease in the field strength or the shifting of the brushes of a constant current motor all accomplish the same thing, the preservation of a uniform speed with various loads and a correct adjustment between the power consumed by the motor and work to be done.

THE SUCCESSFUL JOINT UTILIZATION OF SEVERAL SMALL WATER POWERS.*

BY W. B. JACKSON.

At the present time it is probably not passing beyond the limits of truth to state that the electric current is the most important known transmitting, distributing and translating medium for power and light.

This high position in the arts has been attained only after tremendous struggles in solving the many problems required to make the electric current a suitable and reliable element for commercial use; and many of the most difficult problems yet remain to be solved.

I do not propose to solve these problems in this paper, but wish to present some interesting aspects of electrical construction and operation.

There are certain features in the transmission and utilization of electricity for the production of light and power which have become recognized as of paramount importance in successful commercial installations.

First—Absolute reliability of service.

Second—Uniformly good service.

Third—Economy of operation, including fixed charges.

A few years ago instantaneous or temporary cessations of the lighting and power service were taken more or less as a matter of course; to-day such irregularities are considered grave offenses.

Although it has not been long since the variations of pressure from the normal in distribution circuits might have been measured in fives, and even tens of per cent., without a thought; at present service furnished wherein this pressure variation exceeds two or three per cent. is subject to rightful criticism.

The necessity for the greatest possible economy in operation is more and more marked as the common use of electric current becomes more general, and greater competition enters into its production.

In planning and operating any electric light and power plant these features must be given the best consideration. It may usually be said that when the question of reliability has been solved good service follows as a matter of careful study of the conditions and making the necessary adjustments. These elements bear little or no direct relation to the matter of economical operation.

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* Paper read at the 13th annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 18-20, 1905.

At the present time a marked change is taking place with respect to the sources of power which are being utilized for transformation into the electric current.

Whereas, in times past, cities of from 20,000 to 30,000 inhabitants almost invariably received all the service needed from a single steam plant centrally located in the city; at the present time not a few of the cities of from 15,000 to 30,000 inhabitants are receiving their power and light from two or more electric plants, one or more of these being hydro-electric plants, capable of furnishing all of the electric service required during certain periods of the year and only a portion of it during the remaining time. This is even true of some of the smaller cities.

I have in mind a city of about 17,000 inhabitants, which has no less than three separate hydro-electric plants, two of these being provided with steam auxiliaries. This is the system of the Janesville Electric Company, of which one of our past presidents, Mr. P. H. Korst, is the manager, and in the details of which he takes an intimate interest.

This plant, like numerous others in our Western cities, started many years ago, when the town was young. Its growth was continuous with the town until it was operating about 130 hp. of water wheels and had an engine capacity of 350 hp., located in the center of the city.

About this time it had the opportunity to add to its available power, under favorable conditions, the Fulton hydro-electric plant, at a distance of about twelve miles from the central plant. In this transmission 3-phase alternating current at 60 cycles and 6,000 volts is generated from the power of the Yahara River.

It was not long before further power was required by the company, and it was again enabled to add to its resources another hydro-electric plant. This is its present Monterey plant, located about three miles south of the city, upon the Rock River. Here 350 hp. of water wheels and a 350 hp. engine have been changed from driving a cotton mill (their original sphere of action) to driving a 275 kw. alternating current generator, which furnishes 3-phase current at 60 cycles and 2,300 volts pressure.

Thus the electric company had acquired, step by step, a system comprising:

A centrally located hydro-electric plant with steam auxiliary, together with the requisite distributing circuits and translating devices.

A hydro-electric plant transmitting 3-phase, 6,000 volt alternating current, twelve miles to the central plant.

And a second hydro-electric plant with steam auxiliary, transmitting 3-phase, 2,200 volt electric current three miles to the central plant.

The distributing system comprises a 3 wire, 125 volt direct current service furnishing the lighting and power for the central section of the city; a 500 volt street railway circuit for operating the street railway of the city; 3-phase alternating current distributing circuits for furnishing light and power to the outlying districts of the city, and alternating current series arc lighting circuits.

As the central station had outgrown its quarters, and conditions made it undesirable to remain in its old location, it was decided to build a new plant at a point where a much better hydro-electric development could be accomplished, but still affording a centrally located plant for general distribution throughout the city.

The question then confronted the company of determining the best arrangement for the new plant so as to bring together in one united whole the several plants under their control, in order that they might give the most efficient and most satisfactory results in all of the several classes of service to be supplied by their system.

All of the apparatus in the old station was in excellent condition, but it was in small units. Nevertheless, it was decided to utilize practically all of it in the new plant, adding thereto only what was required to take care of the increasing load.

There are not infrequent cases when old apparatus is thrown aside in the reorganization of electric plants to be replaced by more modern and possibly slightly more efficient apparatus, when the actual added net returns from such a change are far less than the added fixed charges, and which, had the old apparatus been suitably continued in service, would have given thoroughly reliable and satisfactory results for many years to come at a positive net saving to the company.

Some of the details of the Janesville system should be of considerable interest to those concerned with the generation and utilization of electric current.

There are installed in the new central referred to 780 hp. of water wheels driving a single shaft extending through the building. This shaft is appropriately subdivided to permit operating portions of the plant while the others are at rest or undergoing repairs.

Belted to the shaft upon one side are the driving elements, comprising a 350 hp. Corliss engine and two synchronous motors, one for 6,000 volts, the other for 2,200 volts. All of the driven elements, comprising two 125 volt and three 250 volt 75 kw. direct current dynamos and one 110 kw. 500 volt dynamo, can be belted to the shaft from the other side.

Thus suitable space is obtained for all of the driving and driven machinery and at the same time the belt drive of each unit can be arranged to possess the advantages of having the lower belt upon the pulling side.

Although the usual work of the synchronous motors is to receive power from the other plants and assist the water wheels in driving the main shaft of the central plant, yet when desirable they are driven and used to supply the alternating current required for that portion of the lighting and power system.

By the use of transformers located between the 6,000 volt section and the 2,200 volt section of the switchboards, the 6,000 volt apparatus may be operated in connection with the 2,200 volt apparatus with practically the same facility as though everything was at one pressure.

The arrangement of the switchboard is simple, but affords the possibility of operating any one of the plants singly or in any combination with the other plants that the stage of the water may make desirable.

By the arrangement noted a thoroughly practicable and efficient combination is obtained whereby all of the power for supplying the entire service of the electric system may be drawn from any one of the three plants, and two of the plants are equipped so that the power may be furnished either by water or steam, as conditions warrant. An efficient combination of the several plants is thus accomplished and the company is remarkably well fortified against possible interruptions of service. Only a very unusual coincidence can simultaneously disable all the sources of supply.

The ability of the alternating current machine to operate either as generator or synchronous motor, without any changes in its connections or switching devices, becomes of great value in systems like that of the Janesville Electric Company, from the point of view of utility, as already referred to, and also from affording the effect of an equivalent amount of reserve apparatus, thus economizing in space and dispensing with extra driving gear and machinery.

There are not a few plants in operation to-day which might take advantage of this characteristic of alternating current machines to their benefit, but which have not done so. It is not necessary that the conditions of the system should be identical with those of the Janesville Electric Company to make this possible.

In canvassing the necessities of the new central plant it was seen that reserve capacity for the street railway service was highly desirable. This did not appear to be of sufficient moment to warrant the purchase and installation of apparatus which would have to lie idle during almost the entire time. It was therefore decided to add to the one 250 volt direct current dynamo which the company had in use two more like machines, so that any one or more of these could operate upon the three wire lighting and power circuits either in connection with two 125 volt direct current generators or in connection with a balancing set, or so that any two of the machines could be connected in series with each other and thus be used to furnish 500 volt current for the railway. This afforded reserve capacity for the railway while providing necessary machinery for the lighting service.

These two machines were arranged to accomplish this result by being furnished with double throw switches which, when thrown up, put the dynamos individually upon the lighting circuits, and, when thrown down, put the dynamos in series with each other upon the street railway circuits.

At present these dynamos are operated with very little compounding, and it is necessary to adjust their fields to keep the load properly divided when they are running in connection with the two compound wound 125 volt dynamos on the three wire system.

Mr. Korst proposes to have the connections of the series windings which are now on the machines rearranged so that one-half of the turns will be associated with each terminal of the dynamo. This will make it possible for these dynamos to be operated on the three wire system with the 125 volt dynamos and compounded to a corresponding degree.

I might add, that in building the new plant it was deemed advisable to construct the penstocks, forebay and retaining walls entirely of concrete, thus saving the unending repair and depreciation account so prominent in all timber construction used for such purposes.

Further, it was found that concrete blocks could be obtained under satisfactory conditions for the construction of the power house, and this is probably the first electric power house in the State built of these blocks. Thus, in the construction of the buildings, foundations and penstocks, everything between the roof sheathing and the lowest point in the water wheel discharge pits is either of steel, iron or concrete, except the windows and doors and the framing of the wheel house, which latter is covered with corrugated iron.

By bringing these three water powers together into a harmonious system the Janesville Electric Campany furnishes all of the electric light and electric power for the city of Janesville and vicinity as well as some electric light for the city of Edgerton, about 11 miles north of Janesville, almost entirely from water power. This nearly eliminates the use of coal in the operation of their plants.

The company maintains 850 hp. of steam auxiliaries for use in case of emergencies and at times of very low water, but experience shows that the hours of service for these will be few.

FUEL ECONOMY IN ELECTRIC GENERATING STATIONS.

(From our London Correspondent.)

There are few power plants in operation—however modern they may be—in which there does not exist the possibility of effecting numerous economies. Some of our engineers center their efforts upon one particular section of the system, and some upon another, being differently impressed as to the direction in which they can best obtain more economical efficiency. The model plant would be that in which all these ideas for economical working were adopted and giving good results. With a view to promoting a discussion in which engineers might talk of their practical experiences in such directions, a paper on "Fuel Economy in Steam Power Plants" was placed before the Institution of Electrical Engineers in London on January 12, by Messrs. W. H. Booth and J. B. C. Kershaw. In the main they devoted attention to the steam power economy which is to be secured by attention to fuel and its combustion, feed-water and its treatment and heating, furnace design and arrangement, and steam treatment and its use in suitable engines.

Fuel represents 50 per cent. of the total works cost in the generation of electricity, and it is held that from 10 to 20 per cent. of this outlay can be saved by engineers giving greater attention to the regular sampling and testing of fuel. It is too often thought that because fuel is cheap it may be wasted with impunity, but Messrs. Booth and Kershaw contend that much of the inefficiency to be found in the boiler houses of electricity works is to be traced to this fallacy. A check upon the colliery firm or coal merchant supplying the fuel is afforded by a laboratory examination, and this is useful not only in maintaining regularity in the quality of fuel supplied, but also in affording a basis for the new contracts which are, from time to time, made. Experts during the last few years have been continually showing that insufficient attention has been given to the question of adapting the furnace construction and methods of firing to the fuel; the recommendations of boiler makers have been too readily accepted. With suitable furnace construction and scientific control, bituminous fuels can be burnt without causing smoke troubles, and with high efficiency under every type of boiler, thus enabling great saving to be effected in the cost of fuel. But the furnace construction has to be adapted to the fuel, and it must not be supposed that furnaces designed for burning anthracite or semi-anthracite fuel will satisfactorily burn fuels containing 30 per cent. or more of volatile matter.

The correct and incorrect forms of construction for furnaces, the question of air supply, hand-firing versus mechanical stoking, losses by radiation, air leakage and condensation, the heat losses in waste gases, and other points, were all briefly touched upon. It was pointed out that the best results can only be attained if scientific methods of control are employed in relation to feed-water, fuel, waste gases and draught. Automatic apparatus for testing flue gases or any other product can never take the place of the trained chemist, for an automatic apparatus demands not less, but more, skill in its control and management than ordinary apparatus, if the records obtained by it are to be of permanent value. While automatic apparatus is of great service in enabling one skilled and efficient man to increase the number and extent of his duties, and practically to treble or quadruple his efficiency, it does not, and cannot, give accurate and valuable records when placed in the hands of untrained men. This applies to testing apparatus quite as much as to automatic stoking appliances, and the authors of the paper referred to argued that in the working of a modern boiler plant the chemist is as much in place as in a chemical works, and that the recognition of this truth would undoubtedly promote the economical working of such plants.

The benefits to be obtained from the use of durable and efficient storage batteries in combination with lighting and traction generating stations were touched upon. The fullest economy of first cost, and more especially of running cost, are recognized by all station engineers as only obtainable, in the present state of knowledge, by means of a battery, but the fact that the battery is so far from perfect still renders its adoption in any case a matter of grave and careful deliberation.

Proposals Invited.

The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until February 21 for furnishing the navy yards at Boston, New York, League Island, Washington and elsewhere with the following: Schedule 72, arc lamps, rubber covered wire and electrical supplies; schedule 75, cable, battery cells, electric equipments for ammunition hoists; schedule 76, magnet wire, cable, incandescent lamps, mica, electric blowers and electrical supplies. Blank proposals will be furnished upon application to the navy pay offices in the cities mentioned, or to the Bureau. Applications should designate the schedule desired by number.

The Treasury Department, through the Bureau of Printing and Engraving, is inviting sealed proposals until April 11, for furnishing the Bureau with a quantity of electrical supplies during the next fiscal year. Specifications and proposal blanks can be obtained upon application to W. M. Meredith, Director of the Bureau, Washingtnn, D. C.

A Valuable Cyclopedia.

The "Cyclopedia of Applied Electricity" is published in five volumes containing about 2,500 pages and over 3,000 illustrations. It is bound in three-quarters red leather. The list price is $30; special introductory price $18. Published by the American School of Correspondence, at the Armour Institute of Technology, Chicago.

This work is the most comprehensive work on electricity and its practical applications that has yet been published and will prove invaluable to electricians, engineers, telephone and telegraph operators, engineering students, and any person who has occasion to use electricity in any form. To be able to turn quickly to any phase of electricity as used in our great industries is of immense value to both the busy practical man and the engineering student. In these volumes the reader finds a treatment of the latest developments of electricity by acknowledged authorities, fully indexed, and written in a simple, direct way, free from difficult mathematics especially adapted to the needs of the busy practical man.

The work is not addressed to the technically educated specialist, and for this reason all of the descriptions and explanations which it contains have been simplified to the utmost possible degree consistent with a thorough presentation of the subjects treated. Higher mathematics have been entirely omitted, and the subject matter of the work is explained in simple lauguage in connection with a large number of diagrams prepared especially for the text. The halftone engravings are of special value as they illustrate all of the electrical machines and apparatus made by the prominent electrical companies in the United States and therefore acquaint the reader with the types of apparatus used in current engineering practice.

The usefulness of the cyclopedia as a reference book is augmented by the addition of a subject index contained in the fifth volume. The practical value of the work as a whole can hardly be questioned as the cyclopedia embodies the various electrical courses which have been successfully used by the American School of Correspondence in teaching thousands of electricians. The work is, in fact, the outcome of a most successful method for the education of the busy man. It will be found of the greatest value to designers, constructors and operators of electrical machinery, and as it is the only textbook and reference work covering every department of electricity thoroughly, its use will save many valuable hours of search among scattered text-books on electricity.

Appleton Electric Company's Catalogue.

A new catalogue has just been issued by the Appleton Electric Company, 224 Washington Street, Chicago. This enterprising concern carries among other things a complete line of electric lighting and telephone supplies and Marlin cable hangers. A catalogue may be had by addressing the company as above.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JAN. 31, 1905.

Electric Railways and Appliances.

781,116. Motor Car. John Wilkinson, Syracuse, N. Y., assignor to the H. H. Franklin Manufacturing Company, same place. Filed May 17, 1904.

781,268. Underground or Conduit System for Electric Railways. William Cope, Birmingham, Eng. Filed May 24, 1904.

781,316. Guard and Finder for Trolley-Poles. William P. Underhill, Brooklyn, N. Y. Filed May 21, 1904.

781,359. Trolley. Leonard O. Pullen, Augusta, Me., assignor of one-half to Thomas J. Lynch, same place. Filed March 26, 1904.

781,404. Trolley-Pole Support. Thomas J. Cope, Philadelphia, Pa. Filed Oct. 29, 1904.

781,431. Electric-Railway System. Frank E. Kinsman, Plainfield, N.J. Filed Dec. 8, 1903.

781,572-573. Traction-Wheel. Marquis J. Todd, Buffalo, N. Y., assignor to the Buffalo Pitts Company. Filed April 21 and May 9, 1904.

Electric Lights and Appliances.

780,997-781,606. Apparatus for and Method of Producing Oscillatory Currents. Peter C. Hewitt, New York City, assignor to the Cooper Hewitt Electric Company. Original application filed Feb. 9, 1903. Divided and last application filed July 28, 1904.

780,998. Apparatus and Circuits for Starting Electric Lamps. Peter C. Hewitt, New York City, assignor, by mesne assignments, to the Cooper Hewitt Electric Company. Filed April 5, 1900.

780,999-781,000-781,603. Method of and Apparatus for Transforming Electrical Energy. Peter C. Hewitt, New York City, assignor, by mesne assignments, to the Cooper Hewitt Electric Company. Original application filed April 25, 1902. Divided and last application filed Sept. 24, 1902.

781,001-002. Means for and Method of Amplifying Electrical Variations. Peter C. Hewitt, New York City, assignor, by mesne assignments, to the Cooper Hewitt Electric Company. Filed May 16, 1902.

781,016. Incandescent Lamp. Almon D. Page, Newark, N.J., assignor to the General Electric Company. Filed March 18, 1904.

781,226. Incandescent-Lamp Socket. Walter H. Perkins, Waterbury, Conn., assignor to the Waterbury Mfg. Company. Filed Oct. 31, 1904.

781,351. Electric-Lamp Socket. Mortimer Norden, New York City, assignor to Joseph Norden, same place. Filed March 9, 1904.

781,605. Method of Producing Light. Peter C. Hewitt, New York City, assignor to the Cooper Hewitt Electric Company. Original application filed April 25, 1902. Divided and this application filed July 1, 1904.

Electrical Machinery and Apparatus

781,008. Electric Motor. Michel Koener, Chicago, Ill. Filed May 18, 1904.

781,022. Turbine-Wheel Construction. Richard H. Rice, Lynn, Mass., assignor to the General Electric Company. Filed July 22, 1904.

781,035. Commutation of Electric Currents. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed Sept. 17, 1903.

781,134. Interlocking Device for Controllers. Edward H. Dewson, Edgewood Park, Pa., assignor to the Westinghouse Traction Brake Company. Filed June 9, 1903.

781,154. Method of Controlling the Running of Reciprocating Engines or Turbines Driving Alternators in Parallel. Charles A. Parsons, Newcastle-upon-Tyne, and James Swinburne, London, Eng.; said Swinburne assignor to said Parsons. Filed March 30, 1903.

781,307. Transmission-Gearing for Motor-Vehicles. Charles Schmidt, Warren, O., assignor to the Packard Motor Car Company, same place. Filed June 22, 1903.

781,339. Electric Time-Switch. Jacob Helmstadter, Jr., McKeesport, Pa. Filed Dec. 11, 1903.

781,340. Transformer Cut-out. John P. Hetherington and Lewis E. Grubbs, Logansport, Ind.; said Grubbs assignor to said Hetherington. Filed Dec. 28, 1903.

Telephones and Telephone Apparatus.

781,207. Telephone-Relay. William W. Jacques, Boston, Mass. Filed Nov. 3, 1904.

781,225. Rent-Collecting Means for Telephone Service. Joseph L. Peavey, Meridian, Miss. Filed Jan. 15, 1904.

781,237. Telephone System. Charles B. Smith, New York City. Filed Feb. 23, 1901. Renewed Oct. 22, 1902.

781,625. Method of Protecting Telephone-Circuits from the Action of Electromagnetic Waves. John S. Stone, Cambridge, Mass. Filed June 29, 1904.

Miscellaneous.

781,062. Electrical Tool. David J. Hauss and Casper W. Miles, Cincinnati, O., assignors to the Cincinnati Electrical Tool Company. Filed April 24, 1903.

781,077. Electromagnetic Ore-Separator. Erich Langguth, Euskirchen, Germany. Filed Feb. 1, 1904.

781,194. Automatic Code-Ringer for Magneto Signal-Bells. Larkin V. Elliott, Indianapolis, Ind. Filed Feb. 20, 1904.

781,288-289-290. Thermo-Electric Element. Albert L. Marsh, Lake Bluff, Ill., assignor to William A. Spinks & Co., Chicago, Ill. Filed Oct. 18, 1904.

781,319-320-321-322. Signal System. Claude White, St. Louis, Mo., assignor of one-half to Charles T. Noland, same place. Filed Feb. 2 and Aug. 27, 1904.

781,353. Conduit for Electric Wires. Stephen Palmer, Troy, N. Y., assignor to Marcus M. Waterman, James K. P. Pine, James J. Child, Herbert E. Northrup and George W. Daw, same place. Filed Nov. 17, 1903.

781,416-417-418. Electric Telegraph. Willis D. Gregory, Pittsburg, Pa. Filed March 30, 1904.

781,448. Electromagnetic Apparatus. John McIntyre, Jersey City, N. J. Filed Oct. 29, 1904.

THE TELEPHONE WORLD.

Telephone War Expected.

Port Byron, N. Y., promises to be the center of a lively telephone war between the Bell and the Independent interests. For years the Bell people have had the only service available. The new Port Byron Company is already an assured success. The directors are canvassing not only in Port Byron, but Throop, Montezuma, Conquest, Spring Lake and Emerson.

To meet this threatened invasion the Empire State Telephone (Bell) Company has started out on a systematic canvass of that territory. promising to build rural lines and to give cheap rentals, but the farmers believe that they can build and operate their own lines cheaper than they can hire.

A large delegation representing the directors of the new Independent company recently went over to Emerson and the trip resulted in enough new subscribers to build the line to Emerson and Conquest.

The Port Byron Company stands ready to build to Weedsport and establish an exchange there in opposition to the old company

The organization of the Volney Telephone Company in Fulton, N. Y., has been completed with the following officers: President, Robert Simpson, Jr.; vice-president, C. B. Sackett; secretary, Eugene Rowe; treasurer, E. E. Hart. The purpose of the company is to supply telephone service to the farming neighborhood, and the system will co-operate with the Ontario Telephone Company.

Articles of incorporation of the Waitsburg, Wash., Rural Telephone Company, with a capital stock of $10,000, have been filed. The incorporators are all Waitsburg men. The company has control of all the rural telephone lines in the counties of Walla Walla and Columbia and will establish an exchange at Waitsburg.

At the annual meeting of the Barton, Vt., Telephone Exchange Company the following officers were elected: President, H. J. Stannard; manager, E. S. Colliston; secretary, J. N. Webster; committee on admission, M. M. Scott, E. W. Barton and F. W. Baldwin.

The Concord, Neb., Farmers & Merchants' Telephone Company has been organized and has filed articles of incorporation with the Secretary of State. The new company has a capital stock of $10,000.

Chatfield, O., citizens have organized an Independent telephone company and will build a line to connect with the toll lines through Crawford County. The work of construction will begin as soon as the weather will permit.

The directors of the Consolidated Telephone Companies of Pennsylvania recently met in Allentown and elected Hon. R. E. Wright as president.

The Mutual Telephone Company of Rowena, Mo., has arranged to build a telephone line om Rowena to Centralia.

There were 32 Independent telephone corpotions organized in Wisconsin and capitalized at $500,000 during 1904.

Will Fight Bell Company.

Hundreds of Mt. Clemens, Mich., citizens attended the meeting called by the Business Men's Association in the Chamber of Commerce Hall recently to consider the action of the Michigan Telephone Company in raising its rates.

Formerly $12 was charged for residence service and $24 for business houses. Canvassers have been at work for some time and have demanded that all future contracts shall call for $30 for business places, $24 for homes and $18 for two-party lines. A committee has been appointed to see President W. A. Jackson.

If a promise is not secured that the rates will remain as heretofore, a new company to be known as the Macomb County Telephone Company will be organized by Mt. Clemens citizens.

The big telephone deal reported from Pittsburg, Pa., including a combination of 43 of the largest telephone companies in the country, and referred to in the issue of ELECTRICITY of February 1, has been denied by H. S. Howe, a director of the American Telephone & Telegraph Company, who says that "there is absolutely no truth in the report from Pittsburg that a telephone 'trust' is under way." Representatives of the trust have a way of denying everything.

The State of Sinaloa, in Mexico, through Governor Canedo, has granted an important concession to the Culiacan Electric Company, composed of Americans, which was recently organized with a capital stock of $300,000, for the construction and operation of long-distance telephone lines throughout the State and the establishment of local telephone exchanges at Culiacan and Mazatlan.

A joint meeting of the five telephone companies in Phillips County, Col., recently held a meeting in Holyoke, with John Heginbotham as chairman and C. E. Olmsted as secretary, for the purpose of organizing the five companies into one and putting in a central office at Holyoke with a modern switchboard

The contract for 100 telephones used by the United Railways & Electric Company was awarded by the executive committee to the Maryland Telephone & Telegraph Company after a sharp contest. The service will be connected with the largest private branch in the Baltimore telephone service.

The Independent Telephone Company of Plattsmouth, Neb., is showing a great deal of activity in Havelock. It is also building a line between Havelock and Prairie Home.

The higher officials of the Cumberland Telephone Company have under consideration petitions for the installation of a long-distance telephone service between Hattiesburg, Miss., and Jackson, La.

Charles S. Gleed of Topeka has been chosen president of the Missouri & Kansas Telephone Company, to succeed Alonzo Burt.

Independent telephone systems are now being installed in Green Bay and Depere, Wis.

Sale of Telephone Property.

The Augusta, Ga., Telephone & Electric Company's property will probably be bought, when put up for sale at the public sales in March, by a large Western corporation, who will add to the plant extensively, and operate it with much improved conditions.

It was agreed by all parties that the telephone properties be sold at the public sales, and a minimum price of $25,000 be placed on the property. It is also said that the stockholders will buy in the property.

Archibald Blackshear is receiver for the company and L. C. Hayne represents a large portion of the creditors.

The completion of the long-distance telephone line now being built to connect Denver with Omaha and Kansas City will give telephone users a transcontinental service and intercommunication with more than 2,000,000 subscribers. Denver is already connected with San Francisco, and thus a through circuit from New York to the Golden Gate will probably be established.

Terms of the reorganization of the Mexican Telephone Company are announced. According to the plan stockholders will be offered one share of preferred and two shares of common for every nine shares of the present stock. Bonds are offered at 97½ and interest. For additional work $200,000 is required.

The Hastings, Neb., Independent Telephone Company will, as soon as the ground thaws, begin the grading for its new building. This company now has over 110 stockholders, representing over $40,000 worth of stock, and by next year expects to have in operation in Hastings one of the finest plants in the State.

The city council of Mill Creek I. T., has finally passed an ordinance granting a 20-year franchise to the Sulphur Telephone Company to construct and maintain an exchange at that place. It must be in operation within 90 days.

The office of the Corporation Counsel of New York has started an examination of the charters and franchises of the telephone companies as a part of the campaign to compel the companies to make uniform charges for calls between the various boroughs and to put the wires under ground as required by law.

The National Telephone & Electric Company of Clinton, Ill., has purchased the Clinton, Waynesville, Farmer City, Wapella, Weldon, Mansfield and Dewitt exchanges and a number of farmer lines in Macon, Piatt, Dewitt, Champaign, McLean and Logan Counties for $100,000.

The Nebraska Telephone Company has begun work on a new line running east of Beatrice. It is to be a full party line and will be of great convenience to the farming community east of Beatrice.

Blackshear, Ga., will in a very short time have the service of a first-class telephone system.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Cadiz, Ky.—The construction of an electric light plant here is contemplated by A. R. White.

Canastota, N. Y.—A committee has been appointed by the Canastota Business Men's Association to investigate the feasibility of establishing a municipal electric light plant. A. A. Kessler is chairman of the committee and E. Saltsman secretary.

Chestertown, Md.—This town has granted a 40-year franchise to D. S. Pindell of Sault Ste Marie, Mich., to erect and operate an electric light plant.

Clarinda, Ia.—A franchise for the erection of an electric light, heat and power plant here has been granted to the Lee Electric Light Company. C. W. Stuart, city clerk.

Graceville, Fla.—The Graceville Electric Light & Water Company has secured a franchise to operate an electric light plant and construction will shortly begin.

Houlton, Me.—The Houlton Electric Light & Power Company, with a capital of $10,000, has been incorporated by H. T. Frisbee, president, and others.

Huntingdon, Tenn.—The city electric light and waterworks plant is said to have been leased by W. J. Holman, who will make improvements and operate it.

Lorain, O.—This city has decided to purchase the necessary machinery for the installation of a small electric light plant at the pumping station.

Lufkin, Tex.—The Lufkin Electric Light & Power Company, capitalized at $30,000, has been incorporated by S. W. Henderson, G. A. Hackney and others.

Morris, Ill.—The Electric Light Company is planning extensive additions and improvements to its plant on Illinois avenue.

Ogdensburg, N. Y.—A movement has been started toward the equipment of local electric light plants for several hotels and large buildings.

Osceola, Ia.—The light plant here will be enlarged and a hot water plant and day electric power are to be put in.

Renovo, Pa.—Joseph P. Kane of this city has secured the contract for lighting the streets with electricity, and will immediately commence the construction of a municipal and commercial electric lighting plant.

Rome, Ga.—A committee has been appointed by the mayor to prepare a bill to be presented at the next session of the Legislature authorizing this city to build and operate an electric light plant. Its cost will be about $20,000 to build and equip the plant.

Thomson, Ga.—The electric light plant for this city, that has been in course of construction for the past three months, is nearing completion, and it is now thought that by the first of March this place will be illuminated by electricity.

Uniontown, Ala.—This city will build a new and larger waterworks and electric light plant. Thomas Hudson, city clerk.

Willard, Utah.—At a mass meeting of the citizens held lately it was unanimously decided to take steps toward obtaining from Brigham City electricity sufficient to furnish this place the desired power and light necessary.

STREET RAILWAYS.

Auburn, N. Y.—The Auburn & Syracuse Electric Railway Company has purchased the right of way over land owned by the Nelson Beardsley estate in this city, Sennett and Throop. According to the terms of the agreement all electric wires must be kept at least 20 feet from the ground.

Belleville, Mich.—The Michigan Central Railway Company has been granted a franchise to construct and maintain an electric railway.

Clarkston Mich.—The Owosso & Pontiac Electric Railway Company has been granted a franchise to enter this village.

Elgin, Ill.—An electric line will be extended from this city to Wing Park. Mr. Wolf is president of the company.

Fullerton, Cal.—The Pacific Electric Company has been granted a franchise for the right of way for electric lines in this city and cities near by.

Harrodsburg, Ky.—An electric railway will be built between here and Burgin.

Johnstown, N. Y.—A mortgage of $1,750,000 has been given by the Eastern New York Railroad Company to the Metropolitan Trust Company. This is to secure the issue of 5 per cent. bonds of a like amount. The company will build electric railroads from Ballston, N. Y., to this city, Gloversville and Amsterdam.

McKinney, Tex.—A special meeting of the city council was held here recently and a franchise granted for the construction of the tracks of the McKinney-Bonham electric line and operation of the interurban cars within the city limits.

Montreal, Can.—The Ottawa River Railway Company has awarded a contract to M. P. McGrath of Easton, Pa., for the construction of an electric line between Montreal and Ottawa.

Paterson, N. J.—The New York & New Jersey Rapid Transit Company has been organized for the construction next summer of an electric railroad, operated by the third-rail system, which will run from this city to Weehawken, and which, it is expected, will eventually be connected with one of the tunnels in Manhattan. The line, which will be about 14 miles long, will be elevated a large part of the way. The running time between the terminals will be about 20 minutes.

San Marcos, Tex.—A company to construct an electric line from this city to Luling has been organized here.

Standish, Mich.—There is talk of starting an electric road here and connecting this town with Sterling, Alger, Maple Ridge, Melton and Turner.

Uhrichsville, O.—There is talk of an electric railway from here to connect with the contemplated Barnesville and Woodsfield road. It is reported that Canton capitalists are interesting themselves in the project.

Utica, N. Y.—Paul Smith is building the first Adirondack trolley line through a wooded mountainous district. The line will extend to Paul Smith's from Lake Clear Junction, a distance of 19 miles.

Washington, D. C.—One of the largest electric railway projects of the country, which will have this city and Cleveland, O., as terminals, is attracting much attention here. George T. Bishop and Frank H. Gunn of Cleveland have interested capitalists there and elsewhere in the road, and control of the franchises of the uncompleted Washington, Annapolis & Baltimore Electric Road has been secured. This line will be double-tracked to Baltimore. From that city to Cleveland 57 per cent. of the route has already been graded. Construction will begin this spring.

Winona, Ind.—It is reported that the Winona Interurban Railroad Company will erect a power plant to cost, including machinery, $600 000, for furnishing the power for the various proposed electric lines. Sargent & Lundy of Chicago are the engineers.

POWER PLANTS.

Birmingham, Ala.—J. A. Emery, general manager for the Birmingham Railway, Light & Power Company, who has lately returned from New York, where he had been in conference with the majority stockholders of the company and the chief engineers, Ford, Bacon and Davis, announces that the company will during the present year spend a large sum of money on improvements throughout its system of light, heat and power plants in this city. Approximately the sum of $200,000 will be expended in improving the storage bins and making other improvements at the power house.

Wilmington, Del.—Plans for the erection of a power plant to supply light, heat and power for the Pennsylvania Railway Company's new office building and passenger station are being prepared by William H. Cookman, engineer.

BIDS WANTED.

Baltimore, Md.—The Steiner Mantel Company, 8th street and Fairmount avenue, this city, is in the market for electrical equipment and supplies.

Columbia, Va.—Charles Willard & Son want a second-hand small dynamo in good order, capacity 10 to 20 lights, 110 volts.

Cotton Plant, Ark.—The Moore & Priddy Printing Company of this place is in the market for one dynamo, with incandescent lights complete, and wiring.

Delray, Fla.—The Fruit and Vegetable Growers' Association of this city wants prices on one 30 hp. and one 15 hp. engine and two 30 hp. boilers, about 5 x 16.

Drice, Tenn.—H. Davis & Son of this place want catalogues and estimates on equipment for a furniture factory to be driven by an electric power plant.

Jacksonville, Fla.—Rev. J. T. Boone of this city wants prices on electric fixtures.

Knoxville, Tenn.—The Proctor Furniture Company, of which J. C. Sterchi is general manager, is in the market for a 100 hp. engine and 80 hp. boiler.

Norfolk, Va.—The T. W. Worsham Company is in the market for a 100 hp. boiler.

Statesville, N. C.—J. C. Steele & Sons are in the market for storage batteries, 125 volts, that will run fifteen 16 cp. incandescent lights 10 hours on one charge.

Warwick, Ga.—John F. Wise of this city wants a 60 to 70 hp. boiler.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15¼@15⅜c.; casting, 14⅞@15c.

Stockholders of the National Carbon Company will hold their annual meeting at Trenton, N. J., February 27.

Interborough Rapid Transit of New York on Monday made a sensational rise of 14 points, creating a new high record.

The directors of the Brooklyn Rapid Transit Company organized for the year by re-electing the retiring officials.

A member of the executive committee of the Electric Company of America says the new stock issue will not be put out for some weeks.

At the annual meeting on Monday of the stockholders of the Detroit Edison Company the retiring board of directors was re-elected.

The American Telegraph & Cable Company will pay the quarterly dividend of 1¼ per cent. on March 1. Books close February 13 and reopen March 1.

William McKenzie, of Toronto, Canada, with other associates, have arranged for the purchase of the concession for electric car lines for Monterey, Mexico.

There were sharp advances on Monday in Manhattan Railway and Brooklyn Rapid Transit. Third Avenue Railroad was in unusual demand at a material gain.

The annual meeting of the stockholders of the Milwaukee Electric Railway & Light Company will be held at the office of the company in Milwaukee, Wis., February 20.

Senator Minturn, of Hoboken, introduced a bill in the New Jersey Senate Monday night designed to remedy existing evils in the corporation law and drive all corporations not honestly promoted out of the State.

A resolution has been submitted to the Connecticut General Assembly to empower the Hartford & Springfield Street Railway Company to increase its capital stock from $500,000 to $1,000,000. This stock is controlled by Tucker, Anthony & Co.

Fully $25,000,000 was paid out on Friday last to stock holders of the Chicago City Railway Company. It was said to be the largest practically cash transaction ever carried through in Chicago. Something more than 124,000 shares of stock were paid for.

Wall Street is flooded with rumors to the effect that the Metropolitan Street Railway crowd, having failed to sell their road to the New York Subway people, have determined to get possession of that property in order to carry out a merger of all traction companies on Manhattan Island.

The Stanley Electric Manufacturing Company and the General Incandescent Arc Light Company, constituent companies of the General Electric Company, have been consolidated under the name of the Stanley-G. L. Electric Manufacturing Company. All the manufacturing will be done in the present works of the Stanley Company at Pittsfield, Mass.

At the annual meeting of the Western Electric Company, C. S. Holt, C. G. Dubois and J. W. Johnston were retired from the board and were succeeded by Charles Williams, Jr., Charles W. Amory and Thomas Sherwin. The treasurer reported that the total sales for the fiscal year ended November 30 were $32,454,000, as compared with $30,256,000 the previous year, a gain of 7.2 per cent. Net earnings are not yet known owing to delay in reports from foreign companies, but will be materially less than in the previous year.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Feb. 6.
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	171
Metropolitan Street Railway	122⅛
Metropolitan Securities	83¾
Ninth Avenue	197
Third Avenue	182¼
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	62⅝
Interborough Rapid Transit	209
New Orleans Railway	4
Public Service Corporation (New Jersey)	141
Philadelphia.	
Consolidated Traction of New Jersey	82¼
Philadelphia Traction	100¼
Union Traction	58⅞
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	15¼
do. do. do. pref.	59½
West End Street, com	96
do. do. do. pref.	115
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	12⅞
do. do. pref.	51
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	15¾
do. pref.	73¾
Electric Boat, com	42
do. do. pref.	82
Electric Lead Reduction	¼
Electric Vehicle, com	16
do. do. pref.	25
Westinghouse, com	180
do. pref.	192
General Electric	186
Boston.	
Edison Electric Illuminating	251
General Electric	186
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	155
National Carbon, com	42¼
do. do. pref.	114½
Philadelphia.	
Electric Company of America	10¾
Electric Storage Battery, com	78
do. do. do. pref.	78
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	144
Western Telephone Company	22
New England Telephone Company	189½
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210¼
Mexican Telephone Company	1
New York & New Jersey Telephone Company	158¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92¾
Chicago Telephone Company	140
MISCELLANEOUS STOCKS.	
Otis Elevator Company	49
Consolidated Car Heating	64
Standard Underground Cable	200

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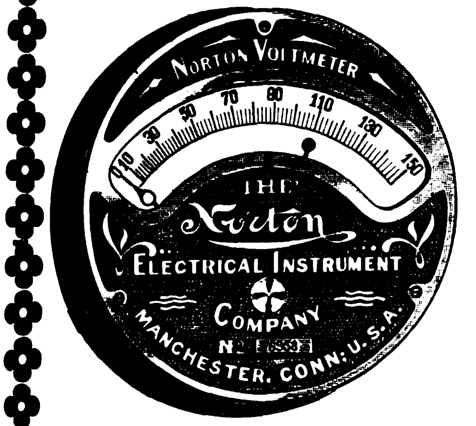
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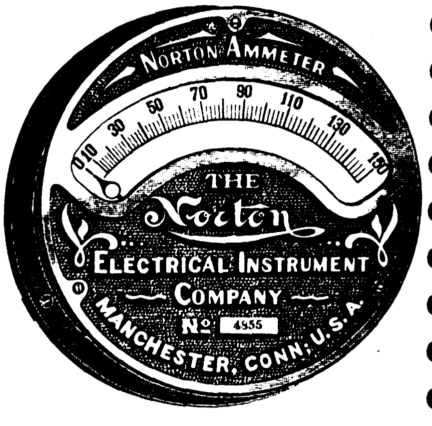
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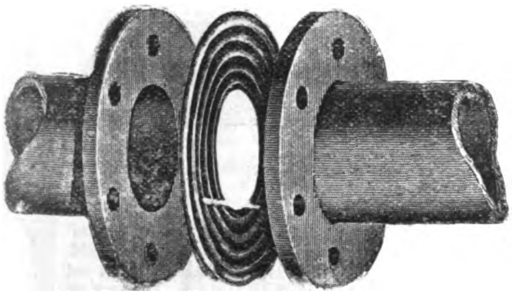

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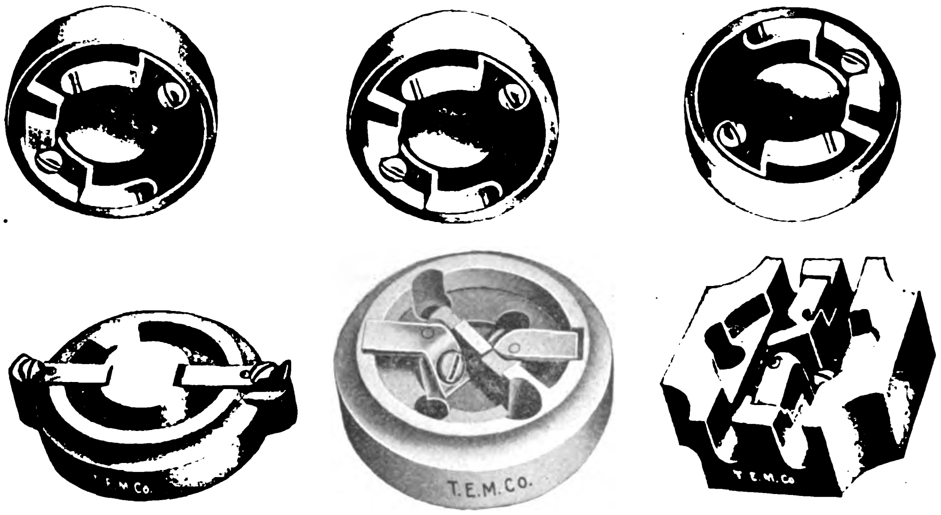

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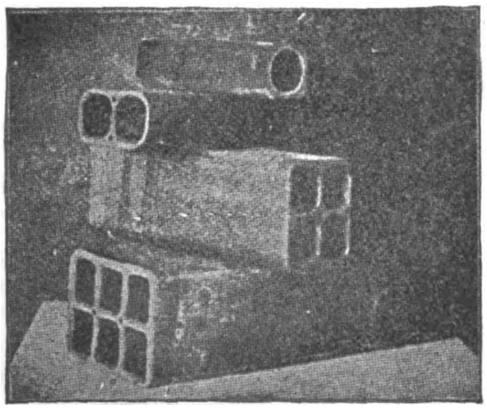

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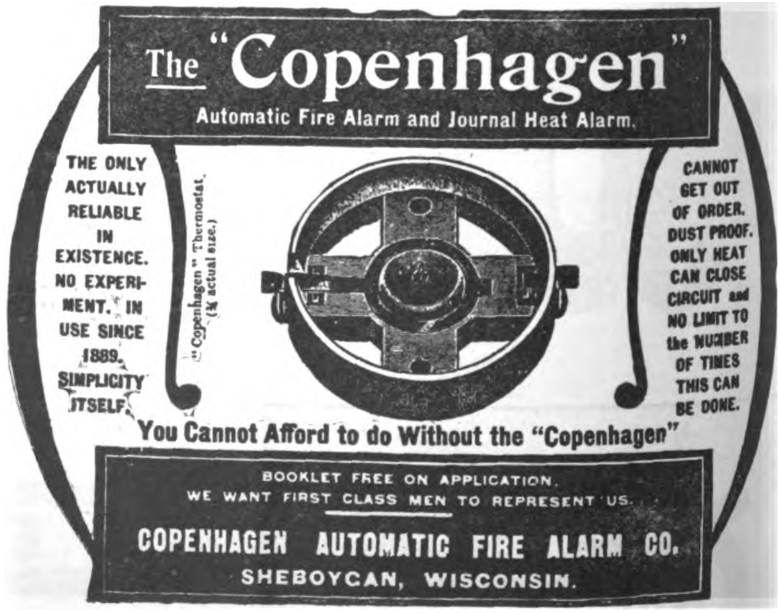
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EDITORIAL NOTES.

Valuable Data on South American Countries.

It cannot be denied that English and German electrical manufacturers cater far more to foreign markets than do the large concerns in this country. This may possibly be due to the fact that the home demand for electrical machinery in the two foreign countries mentioned above is not so great as in the United States, and consequently foreign markets have to be exploited in order to keep the plants running to their full capacity. This would seem a reasonable explanation, for it is hard to believe, and something we are unwilling to admit, that English and German firms have more "goaheadativeness" and enterprise than those on this side of the Atlantic.

And yet the fact remains that at the present time an examination of statistics on electrical imports to South American countries shows that almost without exception England and Germany are far in the lead of the United States.

A perusal of the article elsewhere in this issue, entitled "South American Trade—Exports and Duties," points out several reasons for this. The conditions in Mexico, Costa Rico, Nicaragua, Panama, Salvador, Argentine, Bolivia, Brazil, Chile, Columbia, Ecuador, Paraguay, Peru and Venezuela are touched upon and for each country the duties on electrical machinery and apparatus are given.

To electrical manufacturers or dealers, who are now exporting to any of these countries or who contemplate shipping goods to South America, the information contained in the article in question should prove valuable, and if for no other reason, this issue of ELECTRICITY should be carefully filed away near at hand as a ready means of reference.

* * *

Why Japan is a Marvel in Technical Progress.

No more astounding case has arisen in modern history than that of a nation classed as semi-barbarous leaping in one swift bound to the apex of technical excellence. Japan, an island nation, the subject for comic operas, tea house pictures and a certain class of literature depicting life as an abandonment to a lotus-like existence, has suddenly appeared as a grim warrior, armed with the most modern of armaments and possessing the intellect and tenacity of purpose that would do justice to the most advanced of civilized powers. Certainly this sudden transformation, this stupendous and unanticipated change is due to causes which must be vital in the affairs of any race. It is not that we, of the western world, have refused to believe in the intellectual capacity of those living within the confines of the Orient, but we have accustomed ourselves to the belief that China and Japan were alike—that such progress as we measure out to ourselves in our arts, our literature and our science cannot be attained by other than those of the Caucasian blood.

It is here that the mistake was made—and whether it can be explained by international conceit or an inability to fathom the depths of the oriental nature—the glaring fact remains that Japan has taken her place among the great powers of the world as an equal in the arts, in literature, in science, and most emphatically in naval and military warfare. Thirty years ago, when Russia with one wave of her mailed hand swept away the protestations of the Japanese and seized the island of Saghalien, Japan preserved a discreet silence, but she recognized the source of European strength and in her wisdom began the reconstruction of Japan. She sent her ablest young men far and wide to study these sources of power. The naval and military academies and the university departments of science found their full quota. She skimmed the cream of European knowledge and used it as the first chapter of that vast new volume, modernized Japan. The advantages are obvious. We, of the western world, have slowly toiled ahead, by cutting loose from the retarding influences of a conservatism as deeply rooted as that of the Orient. In our schools and colleges the past has woven its insidious web and as a result, the old-fashioned and time-worn methods of one, two and three centuries ago still to some extent prevail. The Japanese students, free from such bonds, came to the leading universities, colleges and schools. In these they found the knowledge for which they sought. And they took it back to fresh soil, to their own people as yet untouched by European educational influences. This is the reason why Japan within a period of 30 years became a civilized nation. She received her knowledge untrammeled by any older school. Her general progress is not based upon any precedent. She seized upon all that was best and assimilated it. In chemistry, in mechanics, in electricity and in medicine her sons have already made themselves famous. If it is true that the power of discrimination, as our philosophers state, is the highest measure of human intelligence, then in selecting the knowledge best suited to their needs—technical knowledge—the Japanese have shown themselves well worthy of the front rank in the advance guard of human progress.

* * *

A Warning to Bidders. Electrical firms may be interested to learn that the Navy Department has just called attention to the fact that bidders who submit proposals to the Bureau of Supplies and Accounts should be careful to send them in duplicate. Failure to meet this requirement will be regarded as sufficient reason for declaring the bids informal and bidders will run the risk of the loss of the contract.

Attention has also been invited to the fact that bidders who find they have made mistakes in their proposals will run the risk of being required to pay a penalty if they do not execute the contract when it is awarded. In several instances the lowest bidders have discovered they made errors in calculations, and they have asked to be excused from carrying out the contract. When the bids are close, and it may properly be questioned whether an error is excusable, the Navy Department will award the contract on the basis of the original bid. Failure to execute the contract will lead to the payment by the bidder of a sum representing the difference between his own bid and the next lower bid. This will protect the Government. Several instances of this kind have occurred lately, and it is now announced as a policy that the lowest bidder will not find it easy to withdraw his proposal when he learns he has really got the contract. If he refuses to abide by such a decision he will be transferred to the list of those firms that do not have the confidence of the Navy Department in such transactions. It therefore behooves electrical firms to exercise the utmost care in making their calculations, in order to obviate such a difficulty.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

If you have electrical machinery and apparatus for sale examine the Proposals Invited on page 99 of this issue.

◆

The officers of the Iowa Electrical Association have completed arrangements for the fifth annual convention which will be held at the Julien House, Dubuque, April 19 and 20.

◆

The first private wireless telegraph system in this country was put into operation last week at the Schenectady plant of the General Electric Company, and when the station at the Lynn, Mass., plant is completed the company will discontinue all private wires.

◆

A contributor to "Public Works," an English publication, states that the only way canal companies in Great Britain can successfully compete with their rivals is to drain the canals and convert them into electric railways. If canals are a thing of the past and bad investments, why is so much of the people's money being spent on the canals in New York State?

◆

Great interest has been excited among motorists by the report of the trial on the Seine in France of a new kind of motor boat, which is propelled by a 14 hp. De Dion-Bouton motor. The peculiarity of this boat is that the principle of the aeroplane is applied to it, and that it practically glides on the surface of the water instead of through it. The boat in question is about 20 feet long and about half that in width. On the bottom are fixed inclined planes or fins, the angles of which increase as they near the stern. When the boat is at rest it floats, more or less immersed, as an ordinary raft would do; but when under power the bow lifts out of the water and the boat glides along on the inclined planes. It is reported that at the trial the speed over a measured course was at the rate of nearly 20 miles an hour, which is about double the pace that could be got out of an ordinary launch with that power of engine. The boat is fitted with two rudders, between which the propeller works.

◆

The first telephone exchange in England was opened in London in 1879 with 10 subscribers. In 1888 London had 4,900 subscribers, while at the present time there are 100,000 'phones in use. This is 54,000 less than in this city.

◆

The craze for using garbage as fuel for producing steam wherewith to generate electricity for lighting is spreading. Columbus, O., now has the fever, but the city fathers should bear in mind that coal will still have to be purchased, for statistics go to prove that about one-third of the total bulk of this low grade fuel will have to be good anthracite coal, otherwise the fires will go out.

◆

A foreign paper states that the overproduction of trained engineers is causing much alarm in the profession in Berlin, Germany. The competition, it is stated, has become so keen that fully qualified engineers, equipped with the finest training the best technical universities of modern times can give them, are glad to accept appointments with a salary of $25 to $35 a month. The latest proposal is that all university-trained engineers should organize, and by united action make sure of at least a minimum "living wage."

◆

The "Zeitschrift fur Elektrotechnik" of Vienna states that a boat has recently been put into service on the Lake of Geneva, Switzerland, which is driven ordinarily by a 45 hp Diesel engine, running at 260 revolutions per minute, but electric power is made use of at starting and for reversing. The Diesel engine is directly coupled to a dynamo and a small exciter on the one side, while there is a magnetic coupling on the other side through which it can be connected directly to the propeller shaft. An electric motor is also provided, the motor armature being keyed on to the propeller shaft. At starting the Diesel engine is disconnected from the propeller shaft, and drives only the generator and the exciter. The motor is now switched on and its torque and speed are adjusted by regulating the excitation. When full speed has been attained in this way, the motor is switched off and the Diesel engine is directly coupled to the propeller shaft.

Wireless telegraphy is about to be established between the Island of Rhodes and Dernah, a seaport in Tripoli. The Sultan of Turkey has issued an irade which authorizes a German firm to install the system. According to the terms of the irade the service must be able to transmit at least 4,000 words in 24 hours, and the engineers representing the German firm will have to remain in charge of the new system so long as the Turkish Government shall deem necessary.

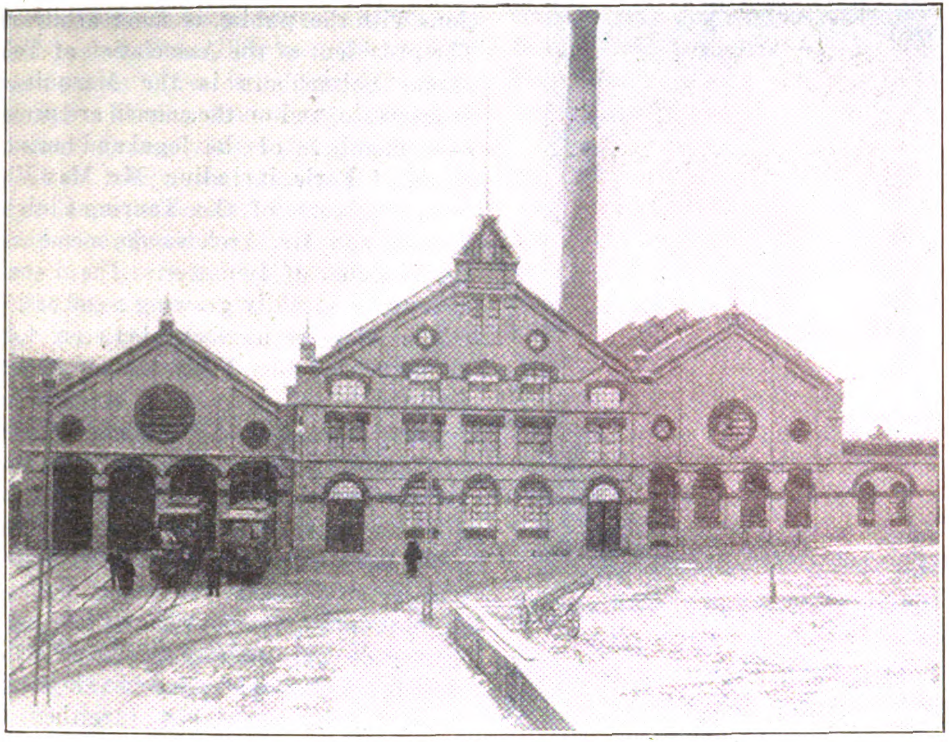
A sleet storm and a sudden fluctuation in temperature last Friday night was responsible for considerable damage to telegraph and telephone wires in this neighborhood and up New York State. West of Rochester most of the telephone wires were down and the telegraph service to Buffalo was seriously crippled.

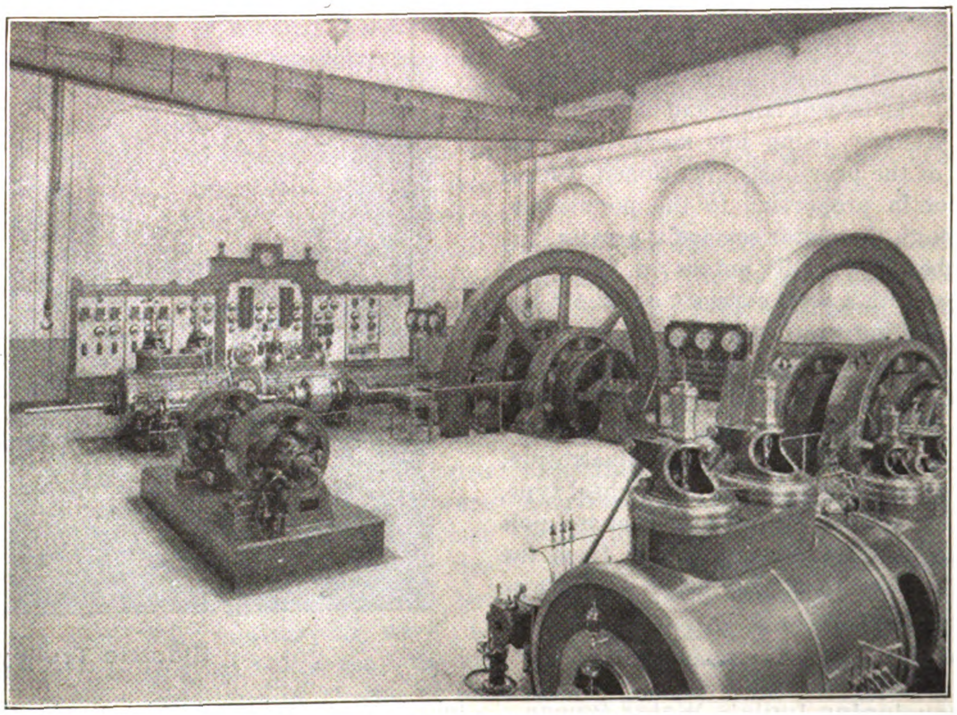
Reports from England state that each battleship of the British Atlantic fleet will shorly be equipped with a wireless telegraphy outfit.

GERMAN LIGHT AND POWER STATIONS SUPPLYING CURRENT FOR ELECTRIC RAILWAYS.

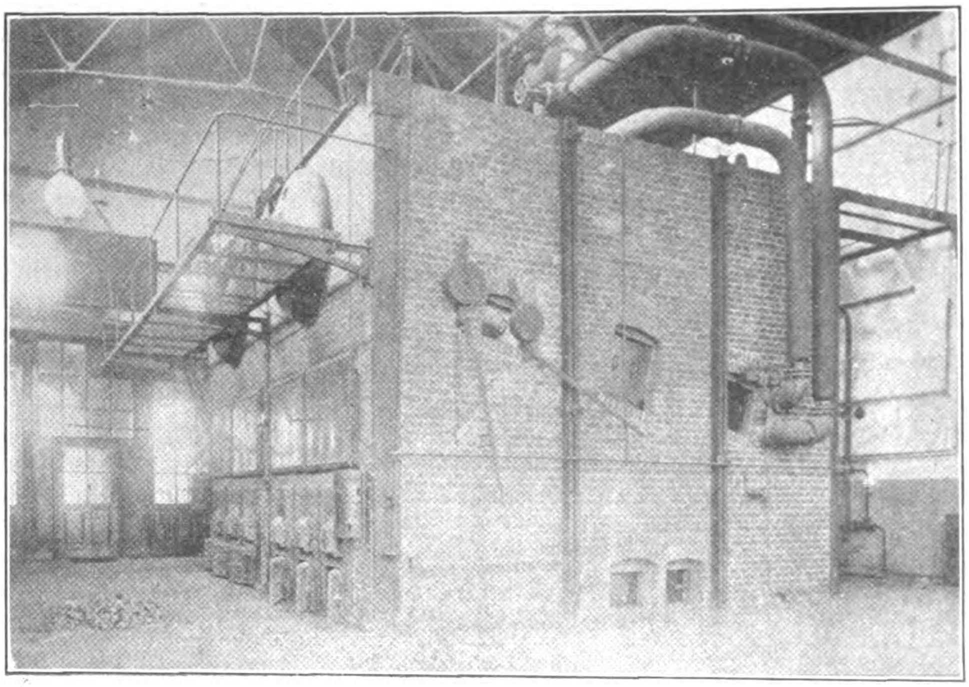
BY FRANK C. PERKINS.

A great many electric lighting stations in Germany and other countries of Europe and the United States find it a profitable business to supply electric current to street railways as well as operating the electric lighting and power distribution service, as the railway work provides a heavy load in the daytime for the electrical plant while the lighting service is at a minimum during this time. The city of Dresden has a lighting plant which supplies such service, and this is also true of the Electricitatswerke der Stadt Gorlitz and the Electricitatswerke Tilsit. The illustrations show this latter station which supplies current to the Strassenbahn Tilsit. The Gorlitz station is equipped with three 200 hp. steam engines and two 400 hp. compound engines of the horizontal type, constructed by the Actien Gesellschaft Gorlitzer Maschinenbau Anstalt und Eisengeisserei in Gorlitz. These engines are operated at a steam pressure of 10 atmospheres and a speed of 125 r.p.m., being directly connected to direct current and alternating current generators constructed by Siemens & Halske. The city of Gorlitz has a population of over 80,000 with an electric lighting service including about 12,000 fifty watt incandescent lamps and 400 ten ampere arc lamps. The current is measured by 372 meters for the above service and the motor distribution includes small machines up to 123 hp. total output. The current for lighting is of the single-phase alternating system with a frequency of 50 periods per second. The distribution pressure is 2,000 volts with a secondary pressure of 110 volts. For the street railway work the generators supply a continuous current of 550 volts pressure operating in connection with a storage battery regulating installation, including 266 cells of accumulators having a capacity of 244 kw.

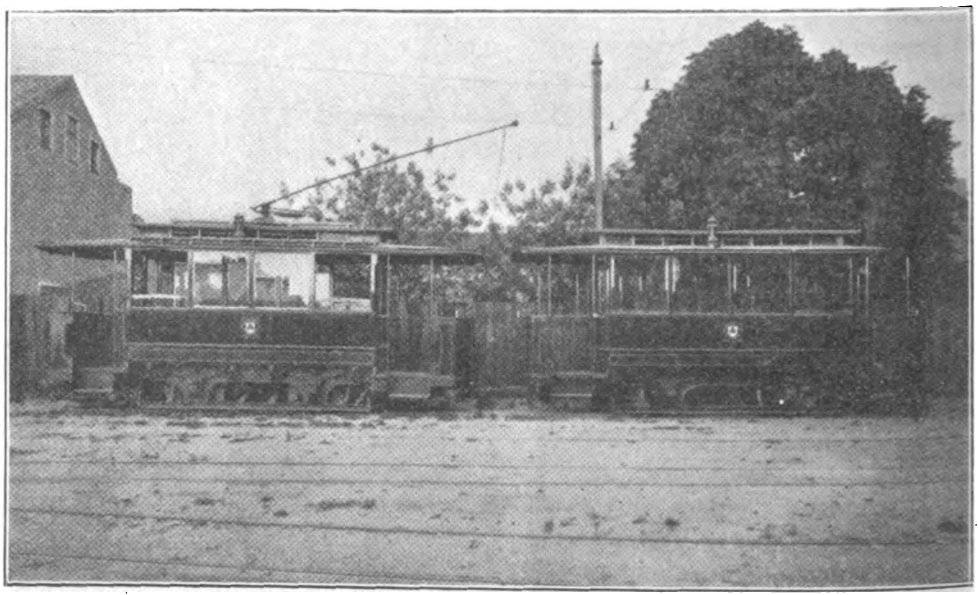

Power Station at Tilsit.


Generator Room of Tilsit Plant.

The accompanying illustration of the Tilsit power house shows the installation of two direct current units, each consisting of a horizontal tandem compound engine directly coupled to two multipolar generators, a heavy flywheel being mounted between them for aiding in speed regulation. These machines have a capacity of 500 kw. and are utilized in connection with a three-wire system for lighting purposes of 220 volts pressure and a 550 volts service for street railway work. The booster set, noted in the foreground of the illustration, is utilized in connection with a storage battery plant with a normal capacity of 150 kw. used as a reserve. The city of Tilsit has a population of 34,538, and the incandescent lighting service includes 3,471 fifty watt incandescent lamps and 98 arc lamps, this number being not more than half that of the previously mentioned central station in proportion to the population, although the motor service is greater, the number of small motors in use being larger with a total capacity of 22,435 hp. This station was installed with electrical equipment by the Elektricitats Actien Gesellschaft, formerly W. Lahmeyer & Co., of Frankfort-on-the-Main, Germany. The cars, as shown in the illustration, are of the single truck, four wheel type, the under running trolley wheel and pole being utilized, thus differing from the contact bow so largely used on German street railways.



Boiler Room of Tilsit Power Plant.



Electric Trolley Cars on Tilsit Railway.

Developing India's Water Power.

An association of British capitalists has been formed and active steps are being taken toward developing the enormous water power running to waste in India and especially in the Punjab. One of the first objects contemplated is to bring to Lahore and Amritsar, both very busy and increasingly important centers of commercial activity, the immense boon of a cheap and ample supply of permanent electrical power.

ANOTHER METROPOLIS DISSATISFIED WITH ITS TELEPHONE SERVICE.*

In May last the dissatisfaction of the Paris public with regard to the inefficient telephone service furnished by the French Administration of Posts and Telegraphs took definite form in the organization of an Association of Telephone Subscribers, constituted for the purpose of bringing sufficient pressure on the Administration to improve the service. The French Telegraph Administration acquired the telephone system of Paris in 1889, and complaint is made that not only is the service very bad, but that the general practice of the Administration with regard to rules and regulations, rates and other matters of business relations with the public, is most arbitrary. The president of the Association of Telephone Subscribers is the Marquis de Montebello, and on the council are prominent members of the legal and business world of Paris, including Mr. Max Vincent, president of the Touring Club de France, and Mr. Archdeacon, member of the Chamber of Deputies. The association has a steadily growing membership, which already numbers between 4,000 and 5,000 of the Paris telephone subscribers.

Since July a monthly bulletin has been published by the association containing articles and reports on the various aspects of the telephone question in France. With a view to acquiring thorough information on the technical side of the telephone service, the council of the association recently retained Mr. Herbert L. Webb, of London, as consulting engineer. Mr. Webb has furnished the association with a report on the general conditions of a modern telephone system and with a further report on the principal causes of the defective service in Paris. Mr. Webb's first report contains a well-written popular description of the central battery system as at present employed in the most modern exchanges in Great Britain. The report even includes a description of the methods for junction working, the French expression "auxiliary" line being used instead of what is called "junction" line in England and "trunk" line in America, in order to facilitate the work of the translator. As Mr. Webb has not been allowed to visit the exchanges, his second report is based on general knowledge of the Paris telephone service acquired from public descriptions and from observations made on visits to Paris during the past few years. He divides telephone exchange working into three periods. During the first period, from 1880 to 1890 or 1892, the methods in use were largely experimental. During the second period of another five or six years, the development of telephonic apparatus was, he says, more scientific, while during the last period effective methods and apparatus have been perfected and standardized.

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*From the "Electrician," London.

The Paris system, in Mr. Webb's opinion, has largely remained in the first period, having only adopted some improvements belonging to the second period mentioned, and being "entirely innocent" of the apparatus and methods of the third period dating from 1897. While these older methods may still be suitable for small exchanges, they should not be applied to larger systems, and, moreover, owing to the defective working of antiquated apparatus, Mr. Webb continues, the nerves of the operators are so taxed that it is unreasonable to expect a high standard of efficiency and discipline from these ladies.

Mr. Webb next criticises the peculiar practice of the French Telephone Department in compelling each subscriber to supply his own telephone set, with the result that there are various types in existence, some having radical technical defects when considered in relation to other apparatus in the system. The variety of instruments also makes it impossible to train a force of inspectors to familiarity with the peculiarities of all the numerous types. A further evil is the extensive use of primary batteries instead of magnetos or a central battery for signaling, a method which, Mr. Webb says, belongs to the first period of telephony already mentioned. The necessity of keeping these cells in order must constitute a serious cause of defective service and also be a source of great expense.

The cure suggested is the reconstruction of the whole system on modern lines, which would occupy two or three years, according to Mr. Webb's computation, during which period a gradual improvement would occur. Mr. Webb does not give an actual estimate of the cost of this conversion, but is of opinion that it would be "far less than the cost of a single battleship, and even less than the cost of an armored cruiser, and well worth the price."

In Paris the total number of telephones is about 45,000, and there is a yearly increase of about 3,600 subscribers. In New York, there is a telephone service serving over 150,000 telephones and increasing at the rate of 30,000 per year. The flat rate of charging in Paris should be abolished, says Mr. Webb, and with a scientifically arranged message rate tariff he thinks it would be possible to reduce the minimum charge to £6 or even £5 per annum.

The Association and the Telephone Administration are still in correspondence with regard to the proposed inspection of the Paris exchanges by Mr. Webb, but we understand that up to the present permission to view the exchanges has been withheld, although the President of the Association has made a formal application to the Administration that Mr. Webb should be allowed to make an official inspection with a view to reporting on their condition and on the apparatus and methods employed.

WIRELESS TELEGRAPHY IN MILITARY FIELD OPERATIONS.

BY A. FREDERICK COLLINS.

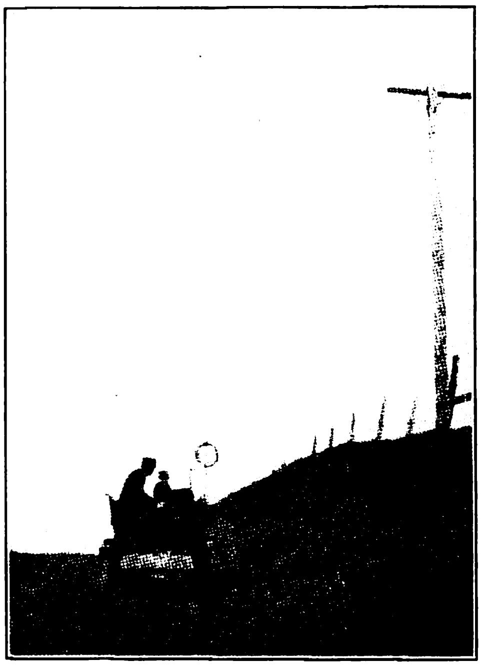
Wireless telegraphy in the Navy is infinitely easier of solution than in the Army, but its importance in the strategic operation of both these branches of the War Department is, with all its imperfections, undeniably great.

The method of sending messages by the system first introduced by Marconi had its initial trial in military manœuvres during the Boer war, when the British Government sent several equipments to South Africa. The results were not over successful, for the apparatus was of a type not readily portable but was intended instead to be permanently installed between certain given points. This was found to be impracticable as the officers could only make use of the equipment at the front; then came the difficulty of transporting 80 or 100-foot masts as well as erecting them; then kites were tried with indifferent success, for they were not adapted to the climatic conditions met with in that country. These untoward state of things, together with the fact that the instruments were as yet of the original bulky type, the art yet young and those in charge of the instruments fresh, nothing more nor less than failure could have been expected.

These unsuccessful results, due both to the system and the men who operated it, spurred Marconi on to greater effort and by the time the war was over he had evolved a wireless telegraph automobile, so arranged that the car contained all the devices for the generation of the initial energy, its transportation and its radiation, together with the receiving and translation appliances, the lofty wire being supplanted by a cylindrical aerial wire that could be folded back on the top of the vehicle.

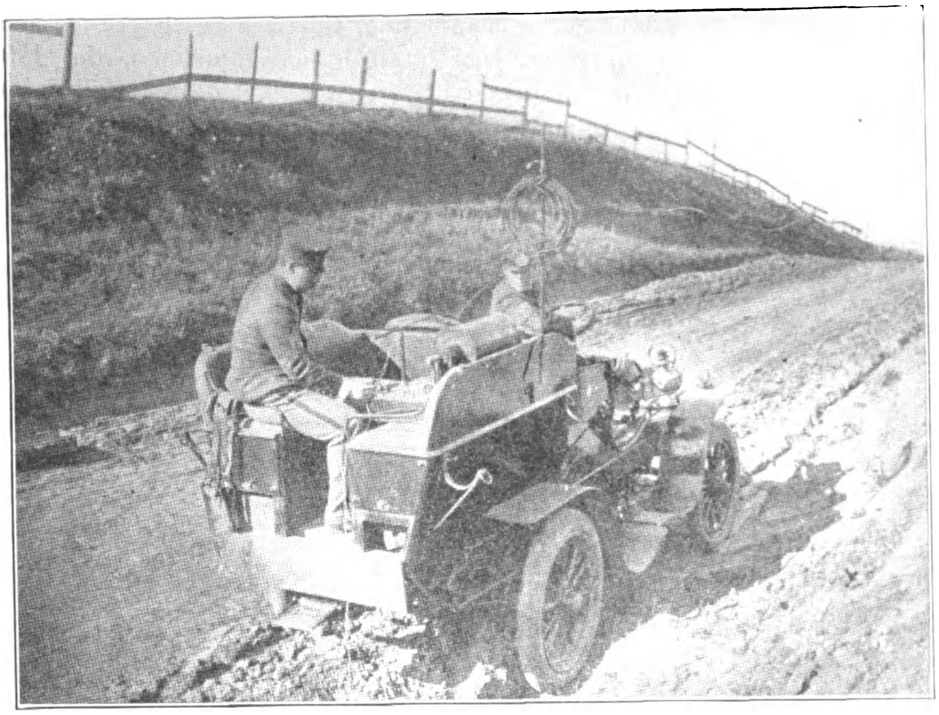
These were the first feeble but, withal, noble steps in the art of designing a portable yet serviceable apparatus for the transmission and reception of wireless telegraph messages that showed the maximum results with a minimum of knowledge on the part of those who had charge of it.

Later the development of the simple microphone detector made it possible to eliminate all the delicate mechanism inherent in the type employing a coherer and Morse register, and the Allgemine Electricitats Gesellschaft, then the owners of the Slaby-Arco system, designed a portable equipment that was subjected to exceedingly severe tests during the manœuvres of the German Army and came out with flying colors.



Temporary Field Wireless Transmitting Station.

In these tests the sending and receiving apparatus were mounted on separate horse-drawn gun carriages, the portable transmitter having a vapor engine and electric generator and the receiver having a microphone detector and head telephone. Kites of the Eddy and Blue-Hill box types and hydrogen balloons were employed, so that in a very light wind or half a gale a suitable kite could be flown or, if there is no wind at all, the aerial wire could be elevated by means of the gas-bag.



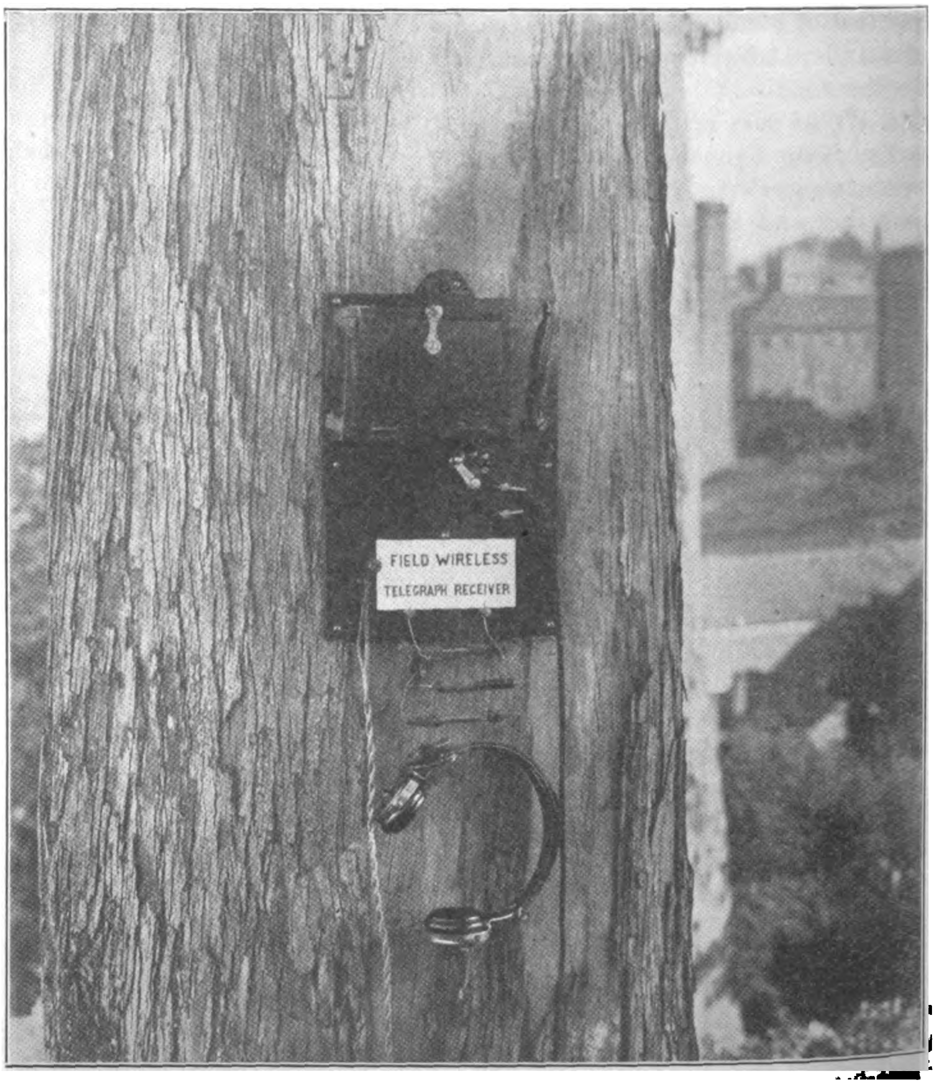
Temporary Field Wireless Telegraph Auto Car.

A modified form of this equipment has combined certain features of the Braun system as well as those of the Slaby-Arco, but its intent, its purpose and its appearance remains practically unchanged. It is noteworthy that a large number of these sets have been supplied by the Russian Government.

Recent experiments by George O. Squire, Ph. D., Major Signal Corps, U. S. A., have indicated a decided advance in portable apparatus for military field operations as well as the methods for utilizing the same. While kites and balloons are far ahead of the primeval attempts to use poles in war manœuvring, yet the former are not without their disadvantages.

In many places it is not, of course, possible to eliminate them, but there are instances where simpler means may be employed without the difficulties of manipulation of these aerial devices which may readily serve to disclose to the enemy the positions of the signal stations. By reducing the complexity of the wireless apparatus to the finality of simplicity and removing those portions of the installation, which include kites, balloons, earth plates, etc., the entire outfit is made compact enough so that it may be conveniently carried on a motor car, as shown in the illustration.

The tests were carried out at Fort Mason, Cal., an automobile having been purchased for the Signal Corps of the Army for telegraphic purposes, and this was fitted temporarily with the wireless apparatus. The initial electromotive force was obtained from two portable storage batteries of 10 volts each and these were used to excite a large induction coil made by Apps of London.



Wireless Telegraph Field Receiver at Fort Mason, Cal.

With the preliminary details thus arranged a tour was made through Santa Clara and Alameda Counties, Cal., when temporary installations were operated at various points along the route. Two different methods were employed in obtaining aerials and earths, both of which are due to Major Squire. One of these consisted of grounding the antenna to the root of a tree by driving a nail into its base, as previously described, the tree serving admirably instead of the aerial wire; in the other the aerial wire was connected to the cross-arm of a telegraph pole while the opposite terminal was earthed in the usual manner.

After a little practice, to quote the Major, two men, a sergeant and a corporal of the Signal Corps, one a good lineman and the other a chauffeur of the machine, who also acted as a telegraph operator, could install a sending station in 10 to 15 minutes; a receiving station was even less trouble to install since there was nothing to transport except what could be carried in the hands.

The best field system of wireless telegraphy for the Army, according to Major Squire, will result only after careful, tedious and exhaustive experiments and tests under the exacting conditions of actual war.

SOUTH AMERICAN TRADE—EXPORTS AND DUTIES.

Every electrical manufacturer we meet these days is to all intents and purposes an exporter as well as a manufacturer, and if proper opportunities and facilities were afforded him it is possible that the foreign shipping branch of his business might be largely developed, not alone to his personal benefit but to the advantage of his commercial community as a whole. The export problem, and it is a thorny subject to many, is one that is hardly ever out of mind. It takes new and sometimes fantastic shapes, and to carry it to a successful issue requires something more than the organization the smallest American manufacturer has at his disposal under present commercial conditions. To say, as is sometimes said, that the export trade in manufactured goods in this country has reached its limit is absolutely childish. It might with just as much reason be argued that a small dealer in opening a store should be content with the first or second week's business and do nothing to increase it.

The ebb and flow of the exports of our manufactured goods are due to causes which, in many cases, are within the control of our manufacturers, and that our foreign shipments, particularly to the countries lying to the south of us, are stationary at times is evidence that we are resting too much on our laurels, existing on victories already won by those who have gone before us, rather than framing our organization and winning fresh ones. To come straight to the point, the men properly qualified to handle our foreign trade are too small in number to adequately carry it on when we consider the enormous competition that has arisen on the part of other manufacturing countries.

Any scheme for the expansion of foreign trade requires a satisfactory arrangement for selling goods. The American electrical manufacturer with an eye for fresh markets should ascertain the duties on his goods when imported into the desired markets. Having satisfied himself that the duties are not prohibitive, and that the products are likely to find sale, he should then find a reliable agent, one in whom perfect confidence can be placed. Orders must be executed based strictly on the samples shown, as it is no use to think that, because the customer is far away, anything will do. The very fact of the distance renders it all the more necessary to exercise even greater care that in the case of home markets when the goods can be rejected and returned in the event that they are found to be unsatisfactory.

MEXICO.

Of course our nearest, and therefore the market to which we have paid the most attention, is that of Mexico. The general effort made on the part of American exporters is to find a man on the spot who can satisfactorily handle goods. As a rule this is not easy to accomplish, and the safest and most advantageous plan from all points of view is to send a representative to the field. Let him go over the ground personally and interest those whom he may find that he thinks would likely make good, permanent representatives; let him be a man thoroughly conversant with the mechanism, technique and purpose of the article or articles which he is seeking to introduce, so that he may be able to present the advantages in the most favorable light. Mexicans, and in fact all South American people, are extremely cautious about taking hold of new ideas, and in this as well as in other countries it is best that all correspondence should be carried on in Spanish. Terms of credit must be decided upon before he leaves the home office, and in this connection it would be well to always make the limit as long as possible, as all European manufacturers are willing to extend long terms, and to secure trade it is necessary in this, as in every other particular, to meet them as nearly as possible upon an equal footing. By this we do not mean that credits should be given indiscriminately.

If it is a very small order, it would be better to try to induce the customer to send cash with the order, as this would save the expense of obtaining a credit rating; if a large bill is sold, ascertain by every means at the disposal of the agent whether or not the customer is deserving of the time to be extended. R. G. Dun & Co. have branch offices in several Mexican cities—Guadalajara, Vera Cruz, Correon and Monterey—and they are always ready to furnish reports on the financial standing of companies, firms and individuals. The usual term of credit extended by European houses is six months, and this is sometimes extended to nine and even twelve months.

In Monterey American manufacturers have a very good control of the market in railway equipment of all kinds—electric street cars, engines, boilers, mining machinery automobiles, etc. This is also true of Tuxpan, and in a measure of Vera Cruz.

During the fiscal year ending June 30, 1904, for which the statistics have not yet been made public, it is found that the export of electrical appliances, including telegraph and telephone instruments, to Mexico reached a total value of $409,921, while those of electrical machinery reached a value of $564,660. The duties prevailing on all importations into Mexico are as follows:

Posts and cross pieces for telegraphs and telephones, free; wire, of copper, brass, bronze or white metal, covered with any material, 5 centavos per kilo, gross weight; bare wire, of copper, brass, bronze or white metal, not exceeding 2 mm. in diameter, 8 centavos per kilo, gross weight; the same, exceeding 2 mm. in diameter, 5 centavos per kilo, gross weight; cables, of copper, brass, bronze or white metal, covered with any material, but without a metallic sheath, and uncovered cables of the same metals, of all diameters, 5 centavos per kilo, gross weight; insulated cables with metallic sheath, free; by sheathed cables are understood electrical conductors which have for their better conservation, in addition to the insulated coverings, one or more metallic coverings over the inner or outer portion of the insulating substance, as well as the conductors, which, in addition to the nucleus of copper, have an interior or exterior covering of iron wire; cables of iron or steel wire, of any diameter, free; insulators for telegraphs and telephones, free; storage and other electric batteries, free; bulbs for incandescent electric lighting, 15 centavos per kilo, gross weight; this number comprises electric light bulbs, i. e., small lamps, such as Swan's, Maxim's, Edison's and the like, consisting of a closed glass bulb furnished with a carbonized filament, producing the light; this condition extends to commutators and sockets forming part of the bulbs, but not to candelabra and chandeliers to which the bulbs are adapted, nor to their globes, reflectors or shades, which must be dutiable according to the component material of chief value or kind, as the case may be; electric arc lamps, 5 centavos per kilo, gross weight; this section refers to lamps for electric arc lights, incandescent lights in the open air, or any other than that of lamp chimneys; the glass globes for protecting the lamps in question, or for softening the brilliancy of the light, are not included in this section, and therefore pay duties as worked glass, according to classification. By "gross weight" is meant the weight of the goods with all of their packages, both interior and exterior, without deducting the cross-framing, straw, shavings, hoops, etc., used for packing: when a package contains different goods dutiable on gross weight, the customs shall establish the tare in proportion to the legal weight attributed to each kind of goods: this "legal weight" is that of the goods with their interior packings; goods dutiable on their gross weight imported without any kind of package, or imported in packages subject to duty, shall pay duty on the total weight of the goods.

CENTRAL AMERICA.

COSTA RICA.

In the markets of Costa Rica the United States is quite an important factor, although we might control a larger share of the market if we cared to extend longer credits. European manufacturers doing business in that country extend credits of four, six, and in some cases, nine months, where we are asking for settlement within thirty days.

The imports from the United States for the past fiscal year included $83,254 of electrical appliances, $4,498 of scientific instruments and $3,172 of electrical machinery.

Duties—Articles for lighting, of metal, 22 centavos per kilo: wire cables, 2 centavos per kilo; glass articles, white or colored, for lighting purposes, 11 centavos per kilo: street railways and their accessories, free.

GUATEMALA.

There is very little soliciting or drumming for trade done in Guatemala, as the merchants and manufacturers order through commission or shipping merchants located at the principal ports abroad. The longest credits are given by Germany and the shortest by the United States. There are no mercantile agencies in the country and inquiries as to financial standings are conducted through the banks.

No exports of electrical machinery were reported from the United States during the past fiscal year, but the returns for electrical apparatus are given as $11,361, and of scientific apparatus, $2,884.

Duties—Electrical machinery and batteries, not charged, destined for public service, free; electrical apparatus, except chemicals employed in the operation of same, 2 centavos per kilo, gross weight; globes, glass, for incandescent lamps, 2 centavos per kilo, gross weight: carbons for galvanic batteries, free: galvanic batteries and their extra parts, free: articles for electric lighting from the United States, free.

NICARAGUA.

The trade of Nicaragua is largely divided between the United States and England, that with the United States being conducted through the mails and by salesmen. The terms of credit granted by the United States are from 60 to 90 days and by England from six to nine months. There are no regular mercantile agencies from whom reports can be obtained, but Consuls and any of the old established houses will give the desired information.

The imports for the past fiscal year included $3,722 worth of electrical appliances, $3,581 of scientific apparatus, and $543 of electrical machinery.

Duties—Telegraph and telephone poles, free; wire, covered or not with any other materials, of copper, 25 centavos per kilo; wire, copper, covered with silk or wool, 50 centavos per kilo; wire, copper or brass, of all kinds, exceeding 3 mm. in diameter, free; insulated copper wire for electric lights, free; electric batteries for industrial purposes, free; electric machines for medical practitioners, 50 centavos per kilo.

PANAMA.

The foreign countries doing most of the trade with Panama are the United States, England, France, Germany and Italy, there is also a small trade with other European countries and with Japan. Here the conditions are somewhat reversed, the major part of the trade with European countries being done through salesmen, and that with the United States through the use of the mails. European datings are usually 90 days, with an occasional extension to six months. With the United States it is chiefly a cash basis that maintains.

In view of the prominence that is being given to this country on account of the construction of the canal, there will be some material growth, and it would be wise for those desirous of extending their fields in this direction to go down and look over the ground, particularly in the cities of Panama, Colon and other towns located in the zone. But there is no boom, such as has been indicated by some glowing reports that have found their way into our papers during recent months. Agricultural and mining possibilities have still to be developed, and there will be a steadily growing necessity for railways of all kinds, and a market for the supply of the necessary equipment for same.

The exports from the United States to Panama within the past fiscal year included electrical machinery to the value of $266, electrical appliances to the value of $6,556, and scientific instruments amounting to $2,982.

Duties—The general provision for unenumerated articles is 15 per cent. of their invoice value; machines, the total weight of which exceeds 1,000 kilos, free; materials for the construction of telegraph lines, free.

SALVADOR.

There seems to be very little to say about the trade relations as they exist at the present time in Salvador, but it is quite evident from the returns for the past fiscal year that there is a good and growing market for the sale of electrical supplies, evidenced by the fact that we sold there electrical appliances and apparatus to a value of $9,925, scientific apparatus to the value of $3,117, and while there were no shipments of electrical machinery it does look as though the prospects for the future in this country are good.

Duties—Scientific instruments free, when not otherwise specified: articles for lighting, lamps, chandeliers, etc., of metal, glass, crystal, and porcelain, with all their accessories, holders, brackets, arcs, burners, etc., of ordinary metal, 25 centavos per kilo: graphite or plumbago in powder, 10 centavos per kilo: machines, electrical, small, 30 centavos per kilo: articles, apparatus, tools, and materials not specified, for railroads, telegraphs, electric light, 1 centavo per kilo.

SOUTH AMERICA.

ARGENTINE.

Electrical enterprise has received great impetus in this country during the past few years, and there is still a large and growing field open to it. Rapid strides have been made in developing the resources of the country. Notwithstanding its area of 1,319,247 square miles, it has only a white population of about 5,000,000.

Through its diplomats at Washington Argentine has asked for what it describes as reasonable reciprocal tariff concessions, claiming that if an agreement can be reached on this matter the present trade between the two countries can be trebled in volume. A strong appeal has been made and the assistance of the United States has been asked for the purpose of developing American trade in this way. This request follows closely upon the installation of improved facilities for transporting commercial commodities through the country and the introduction of fast mail and passenger steamers between New York and points on the River La Plata.

Argentine stands third in the list of South American countries in its receipts of electrical machinery from the United States during the fiscal year of 1904, with a value of $30,741; also third in its receipts of electrical appliances, with a value of $115,686, and of scientific instruments the total import value from this country was $40,660, the highest shipments made to any of the South American countries in this particular line of industry.

Duties—Accessories of all kinds, such as switches, or fusible wire, interrupters, alarm keys, buttons, commutators of all shapes and systems, with porcelain base and cover, 25 per cent. on a valuation of 55 centavos per kilo; the same, with porcelain base and metal or paper mache cover, 25 per cent. ad valorem on a valuation of 90 centavos per kilo, the same, with slate or marble base, with or without cover, 25 per cent. on a valuation of 120 centavos per kilo; the same, in the form of spare parts of bronze or copper, without their bases of porcelain, slate or marble, 25 per cent. ad valorem, 2 pesos and 50 centavos per kilo; bronze sockets and connections, 1 peso and 50 centavos, duty 25 per cent; insulators, glass, 6 centavos per kilo gross; insulators, earthenware, or porcelain, of more than three cm. in diameter, with or without hooks. 12 centavos per kilo, gross; the same up to 3 cm. in diameter; 25 centavos per kilo, gross; wire, or cables of copper, up to 5 mm. in diameter, covered with cotton, gutta-percha or other materials, excluding wire covered with lead or silk and flexible cords of all kinds, 70 centavos per kilo; the same, of more than 5 mm. in diameter, 60 centavos per kilo; the same, up to 5 mm. in diameter, covered with lead, 50 centavos per kilo; the same, of more than 5 mm. 50 centavos per kilo; the same, of whatever diameter, covered with silk, 50 centavos per kilo; the diameter of the wire is calculated on the wire itself; wire, strengthened, underground, with interior envelope of lead and iron or steel armor, 40 centavos per kilo; the same, of iron or steel, covered with cotton, gutta-percha, or other materials, 30 centavos per kilo; wire, flexible cords, with two or more conductors of copper, spiral-shaped, of any diameter, covered with cotton, wool or other materials except silk, 1 peso and 50 centavos per kilo; the same, covered with silk, 2 pesos and 50 centavos per kilo; Morse's telegraphic apparatus, 18 pesos each; sheaths or tubes of porcelain, 12 centavos per kilo; articles for lighting not mentioned, of bronze or yellow metal, whether nickeled or silvered or not, with or without glass parts, 1 peso and 50 centavos per kilo; the same, of iron or zinc, of all kinds, 25 centavos per kilo: knobs, wooden, for electric bells, 40 centavos per dozen; the same, pear-shaped, and other kinds, 80 centavos per dozen: electric bells, 50 centavos each; carbons for arc lamps, 20 centavos per gross kilo; insulating tape of any materials, 1 peso and 10 centavos per kilo; electric light meters or regulators, 12 pesos each: vulcanized fiber in plates, 50 centavos per kilo: vulcanized fiber in tubes or bars, 1 peso and 60 centavos per kilo; portable galvanometers, 8 pesos each; arc lamps or regulators and their corresponding resistances, fittings and globes, up to 60 cm. in height, except bulbs and supports, 12 pesos each; same, more than 1 meter, except bulbs and supports, 20 pesos each: incandescent lamps, 2 pesos per dozen; electrodes of copper or bronze for batteries, 40 centavos per kilo; same, of zinc, 15 centavos per kilo; electric motors for fans, complete or not, 10 pesos each; hooks of iron for insulators, 12 centavos per kilo; batteries of all kinds, 25 centavos per kilo; porous jars, charged, for batteries, 12 centavos per kilo, gross; same, not charged, 20 centavos per kilo, gross; suspensions of porcelain for incandescent lamps, with glass, 35 centavos per kilo; telephones, magnetic, finished or not, 7 pesos each; insulating tubes of Bergmann's system, with accessories, such as sockets, elbows, etc., not coppered, 30 centavos per kilo; same, coppered, 40 centavos per kilo; same, of iron, 15 centavos per kilo; jars of glass for batteries and accumulators, of any form and size, 7 centavos per kilo; same, of earthenware or varnished, 10 centavos per kilo. In each instance the word evaluation should precede figures in the foregoing, and the duty on the articles enumerated is 25 per cent. of the evaluation as given.

BOLIVIA.

Not very much can be said of the present outlook for electrical manufacturers with the exploiting of their wares in Bolivia at the present time, as there is not a single dollar's worth of exports along these lines reported from the United States during the past fiscal year. The trade, quite large in the aggregate, is almost exclusively in the hands of German manufacturers, as the demand is for cheap articles, a fact to which the Germans cater whenever they find it to exist.

Duties—The very explicit customs regulations are very rigid and provide for every detail of consular invoices, manifests, samples, etc. The evaluation is set by the customs authorities, and the percentage to be paid is calculated on this evaluation; insulators, for telegraphs and telephones, 35 centavos gross weight, free; wire conductors for electric currents, including packages, 42 centavos per kilo, free; iron, wire, for telegraphs, etc., 80 centavos per kilo, free; accessories for telegraphs and telephones, free; cable wire, free; lamps and furnishings for electric lighting, free.

BRAZIL.

Electrical firms wishing to do business with Brazil need first to study the markets and become acquainted with their wishes and peculiarities. A good commercial traveler who can speak Portuguese is worth more than a ton of circulars and catalogues, which are seldom read even when printed in Portuguese, the language of the country, and they are practically useless when they are printed in English, which is almost unknown. It is surprising to see that some of our very largest firms do not realize these facts.

The terms of credit are with the European house from 60 to 90 days, and in some instances six months, while from the United States the request is nearly always that the business shall be conducted on a cash basis. Notwithstanding the adverse conditions under which we are laboring our trade with Brazil in electrical instruments and machinery during the past year amounted to more than that of any other South American country—$125,661; in electrical appliances the values were $271,120, and in scientific instruments, $32,744.

Duties—Receptacles and vessels of earthenware, for batteries, insulators and all other articles combined or not with copper fittings for electric installations, 200 reis per kilo; wire cables, 48 per cent. ad valorem; electric machinery, 15 per cent. ad valorem.

CHILE.

The outlook for American trade with Chile and the entire southwest coast is fairly promising. It would be eminently so if some means could be devised to enable us to successfully compete with European countries in the matter of transportation facilities. The principal contributors of supplies for those markets are England, Germany, France, Italy, Spain, Peru, Australia and Canada. Business is conducted both by traveling salesmen and through commercial agencies. The terms of credit asked and granted by most manufacturing countries are 90 days after the receipt of the goods, although this is sometimes further extended if the exigencies of the case seem to demand it.

Our own exports of electrical machinery to that country during the fiscal year ending June 30, 1904, were given as $20,355; of electrical appliances at $48,805, and of scientific instruments at $20,534. This is encouraging and is an evidence that there is a market to be developed if the proper care is given to it.

Duties—wooden pushes for electric bells, 6 pesos and 50 centavos per kilo, including package, duty 25 per cent.; cross arms for telegraph poles, 30 centavos per kilo, duty 25 per cent.; telephonic and telegraphic apparatus, insulators, iron or steel posts and other appliances for telegraphs and telephones, except wooden brackets for posts, free; machines, apparatus, and special accessories for illuminating by electricity, except lamps of all kinds, but including bulbs and candles, free; iron or steel plant for railroads, whether steam, animal or electric traction, free, with the exception of such material as may be dutiable at 15 per cent. ad valorem.

COLOMBIA.

Colombia is commercially burdened in various ways. Not only is it dependent largely upon its export trade for the conditions commercially in all lines within its boundaries, but it is also burdened with a standing army and a very expensive consular service, both far beyond its means. Our exports to Colombia during 1904 only amounted to $4,601 in electrical machinery, $22,791 in electrical instruments and appliances, and $7,412 in scientific apparatus.

Duties—Materials for public railways of all kinds and telegraph wire for public use, free; same, for private use, 2½ centavos per kilo; motors of all kinds and of any power, 2½ centavos per kilo; to the foregoing are to be added surtax charges, which vary from time to time, according to discretion of the Government.

ECUADOR.

Nearly all the exporting manufacturing countries find markets in Ecuador, and there are constantly increasing opportunities for new trade. The terms of credit extended by the United States are from 30 to 60 days from the date of invoice, while from European countries they are six and more often nine months from date of invoice.

Our exports of electrical instruments in 1904 were placed at $15,375, of scientific apparatus at $2,920, and of electrical machinery at only $154.

Duties—Railway plant and accessories of every description, free; conduits, 2 centavos per kilo; telephonic and telegraphic apparatus, 25 centavos per kilo.

PARAGUAY.

Not much business can be expected between the United States and Paraguay until such time as we have better transportation and banking facilities. At the present time all money has to be sent through some London bank. Large quantities of American goods are being sold in the markets of that country, but we get no credit for them as they are sold through German, French and English agencies, and are considered by the inhabitants to be of the manufacture of the countries through whose agencies they are received.

Duties—general articles, unenumerated, 35 per cent. ad valorem; telegraph wire, scientific instruments and railroad equipment, free.

PERU.

There is a large and constantly increasing trade to be secured in Peru, but to do so American manufacturers must conform to the practice of European countries, i.e., send competent traveling men, well versed in the Spanish language, who understand the customs of the country and the local methods of business. Great Britain is the largest shipper, and the United States, while millions of dollars behind her, is fast becoming a strong factor in this market.

There is a very bright future for the electrical manufacturer in that country if the business is properly handled. During last year Peru furnished the second largest South American markets in electrical appliances and instruments, amounting to $140,005; and the same is true with regard to our exports of electrical machinery, the total value of which amounted to $90,802.

Duties—The duties are 40 per cent. on an appraised evaluation as follows: Accessories generally, such as switches, contact makers, interrupters or alarm-keys, buttons, commutators of any shape or system, with porcelain base and cover, 60 centavos per kilo; insulators of glass, 7 centavos per kilo, gross weight; same, of earthenware or porcelain, exceeding 3 cm. in dimeter, with or without hooks, 15 centavos per kilo, gross weight; same, not exceeding 3 cm. in diameter, 30 centavos per kilo, gross weight; wire or cables of copper, up to 5 mm. diameter, covered with cotton, gutta-percha or other material, excepting those enveloped in lead or silk and flexible cords of all kinds, 85 centavos per kilo; same, exceeding 5 mm. in diameter, 7 centavos per kilo; same, up to 5 mm. in diameter, covered with lead, 60 centavos per kilo; conducting cables for electricity, with lead cover and iron and steel frame, 5 centavos per kilo; same, of iron or steel, covered with cotton, gutta-percha, or other materials, 4 centavos per kilo; flexible cords, with two or more conducting wires of copper, spiral shaped, of any diameter, covered with cotton, wool or other material, 2 sols and 50 centavos per kilo; same, covered with silk, 3 sols and 75 centavos per kilo; ordinary knobs of wood for electric bells, 50 centavos per dozen; same, pear-shaped and other kinds, 1 sol per dozen; electric bells, 1 sol each; carbons for arc lamps, 18 centavos per kilo, gross weight; insulating tape of any material, 1 sol and 40 centavos per kilo; electric light meters or regulators, 15 sols each; arc lamps or regulators, with corresponding resistance arrangements, fittings and bulbs, of a total length under 60 cm. each, 15 sols each; same, from 60 cm. to 1 m. in length, 22 sols and 50 centavos each; same, exceeding 1 m. in length, 30 sols each; incandescent lamps, 3 sols and 50 centavos per dozen; hooks of iron for insulators, 15 centavos per kilo; porous jars, charged, for batteries, 15 centavos per kilo, gross weight; hangers of porcelain for small incandescent lamps and for lanterns, with glass, 45 centavos per kilo; same with claws, sockets and connections of bronze, 50 centavos per kilo; telephones, magnet, 9 sols each; insulating pipes with their adjuncts, such as elbows, sockets, and other parts, not being covered with copper, 35 centavos per kilo; same, covered with copper, 50 centavos per kilo.

VENEZUELA.

In Venezuela again we are at the disadvantage of short credits, the usual request being for cash with the order, or remittance by return mail, whereas when goods are imported from European houses the credits are from three to six months, and this is in the favor of the merchants in that country, who, as a rule, have not a sufficient capital invested to enable them to pay cash on delivery.

Our exports direct to Venezuela during the past year reached a value of $58,074 for electrical appliances, $11,567 for scientific apparatus, and $943 for electrical machinery, of which large quantities were shipped through European countries.

Duties—Accessories and complementary parts for telephone lines, 30 centavos per kilo; accessories and materials for railroads, free; telephonic apparatus, 30 centavos per kilo; cables, 30 centavos per kilo; carbons, coal and carbons for electric lighting, and telegraph machinery and apparatus, free.

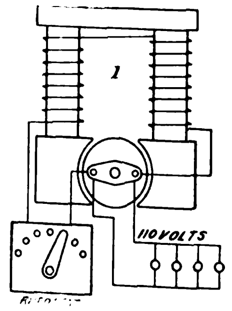
ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

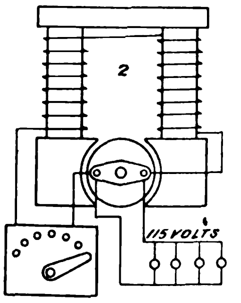
ELECTRIC LIGHTING.

Incandescent Lighting.—The lighting of incandescent lamps is one of the most important departments of electric lighting in large cities. It is done by means of alternating as well as direct current. If a direct current system of lighting, the character of the dynamo employed will be either shunt or compound wound. When conducted on an enormous scale, as in the case of stations which supply an entire city with electricity for light and power, low tension direct current lighting is associated with high tension two or three-phase alternating. This last, as will be shown, is employed to further the economy of transmission to points more or less distant from the original generating plant. In other words, the use of high tension alternating currents, in conjunction with low tension direct, is for the purpose of instituting a series of secondary or distributing stations, substations as they are called, which are utilized as new centers of electrical supply.

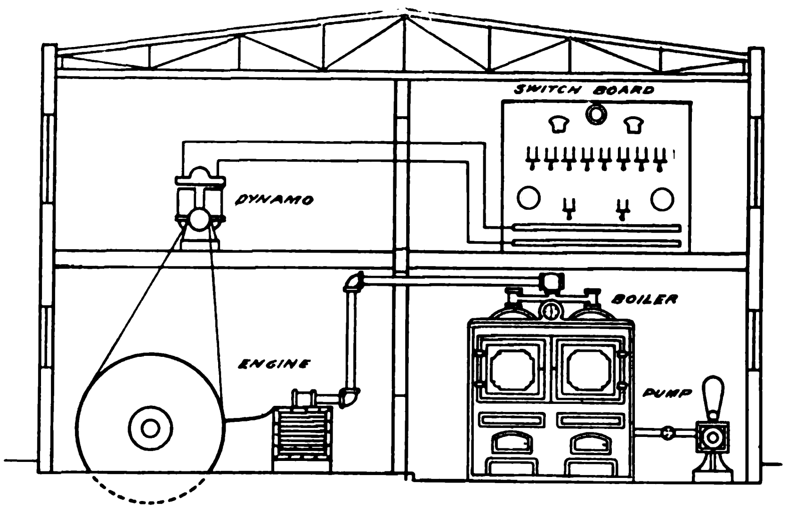
Regulation of Shunt and Compound Wound Dynamos.—The machines eminently suited to the service of supplying an incandescent system with its energy are the shunt and compound wound dynamos. They are installed under circumstances which require consideration. For instance, it is customary to use compound wound generators for private installations. In this case, the dynamo is practically automatic in its action, which means, that between no load and full load, the minimum and maximum of lights, it will preserve a comparatively uniform pressure. On the other hand, if a shunt dynamo is installed, every important change in the number of lights will necessitate an adjustment of the resistance inserted in the field or shunt winding. When the various consumers of the current turn the current on or off, the dynamo, sensitive to such changes, will vary its terminal or brush pressure. A weaker or heavier current coming from the armature will raise or lower the potential difference at the brushes. Constant watching is required to preserve a uniform potential by increasing or diminishing the current in the shunt winding. When the current in the winding of the fields is increased by cutting down the resistance in the rheostat, the amperes or ampere turns of said winding increases. The lines of force of the field increase, and the EMF. generated by the dynamo. The reverse happens when the resistance in the field winding is increased. The smaller a shunt wound generator the more constant must the attention be to this method of regulation. If the generator is very large, such, in fact, as have been employed in the Edison station in New York City, where the station load reaches over 200,000 amperes, then the use of shunt wound generators with such regulation as described is good practice. In this case, station assistants are always at the rheostats to meet the rising or falling tide of electricity with a resistance adjusted to preserve the constant potential character of the system. Contrary to expectations this is a very reliable method of regulation and meets every requirement, many, perhaps, which might be overstepped by dependence upon a purely automatic system.



1—Some resistance in shunt coils, gives a pressure of 110 volts.



2—No resistance in shunt coils, gives a pressure of 115 volts.

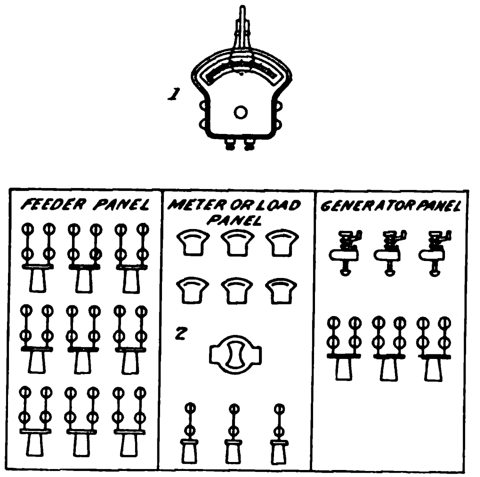


ESSENTIAL PARTS OF AN ELECTRIC PLANT.

A Private Electric Light Plant.—The essentials of a private electric light plant might be classed under the following heads:

Mechanical.	Electrical.	
Boiler.	Dynamos.	Circuit Breakers.
Pumps.	Switchboard	Lightning Arresters.
Engine.	Wiring.	Ground Detectors.
Steam Fittings.		Main Switches.

The dynamo, switchboard and wiring are necessarily parts of the same system, that is to say, if the building has been wired with the two or three-wire system the switchboard would be equipped, and the dynamo or dynamos connected up in accordance with this plan. The dynamo, whether shunt or compound wound, would be supplied with a rheostat and a voltmeter and ammeter.

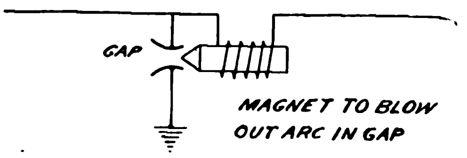


1—Station type of Weston meter—illuminated dial. 2—Departments of a switchboard.

The Switchboard.—The switchboard can be best understood with reference to a classification which takes into consideration the various functions it is to perform as follows: Parts of a switchboard:

- Generating Department.
- Distributing Department.
- Metering Department.

By this is meant that there are three functions performed by a switchboard—to receive the main wires from the generator or generators, to distribute or feed this current to the various circuits connected all over the building and to measure or meter the energy both as regards its volts and amperes separately, as well as its watts in total. It is now possible to purchase small switchboards which are



Lightning Arrester with Magnetic Blow-out.

merely parts of a complete board, called "generator, feeder and meter panels."

Lightning Arresters.—Central station as well as private plants are subjected, to a greater or less extent, to the influence of lightning or electrical storms. The electrostatic discharge must be led to the earth before it reaches the generator. To accomplish this, use is made of the principles in static and dynamic electricity which govern the movement of the charge. These ideas are embodied in a device called a lightning arrester. It is invariably supplied with either an air-gap proper or a very high resistance path leading to the earth. The lightning discharge is thus given the choice of continuing along the circuit where it will meet with retarding or impeding influences, or of reaching across the gap provided and reaching the earth at once. Kicking coils are employed between the line and the generator where the system extends beyond the station or private plant, to artificially augment the difficulties a static discharge will meet with in advancing on the machines. The inductive reaction or electrical kick, as it is called, proves an effective protection in conjunction with the arrester against sudden rises of potential in the system. These electrostatic surges of pressure attack the integrity of the line and plant by tending to break down the insulation, and thus cause grounds or short circuits.

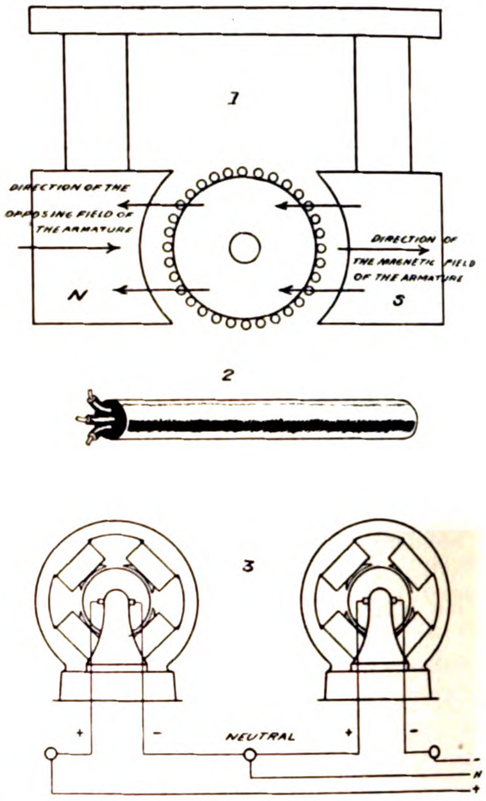
The Incandescent Lamp.—Not the least in importance is the lamp itself, on whose virtues hang the successes which are to follow. The incandescent lamp represents the source of illumination from one standpoint. From the other, it must be regarded as the basis for the most important of all calculations in the way of economy and efficiency. There are three features to an incandescent lamp which bear upon the question of a plant's success. They are the life, candle power and efficiency of the lamp. The average life of an ordinary 16 candle power lamp is about 600 hours. The candle power is rated as 16 with the normal pressure in the circuit. The efficiency of an incandescent lamp, or its wattage per candle power, generally reaches between 3 and 4. By this is meant that a 16 cp. lamp may consume anywhere from 16 × 3 to 16 × 4 watts to produce its light. The manufacturers of incandescent lamps have learned by experience that any increase in the efficiency of lamps, any increase in the candle power and decrease in the watts consumed, is only gained at the expense of the life of the lamp.

The problem therefore becomes self-evident, when it is known that an increase in a few volts will so rapidly raise the cp. of a lamp that it falls within the category of less than 3 watts per cp. If the normal pressure is reduced the same holds true in a reverse sense. In this case the lamp takes more than 4 watts per cp. and is very inefficient.

Regulation, as it is called, that is to say, the preservation of a uniform potential in the entire system of electric lighting is necessary if any relationship is to be kept between the light produced and the power consumed in producing it. A fall of a few volts in the generator means a reduction of between 20 and 30 per cent. in the candle power of the lamps. A rise of a few volts, will send so much more current through the lamps and so increase the candle power, that the life or durability of the lamps is reduced. The increase in current with a few volts, is due to the lowering of the resistance of the carbon as its temperature rises. A hot carbon conducts much better than one that is cold, and when, as in the case of a carbon lamp filament, incandescence is reached, it becomes very sensitive to a slight increase in pressure.

Power Consumption and Lamp Life.—These two factors are closely associated in the statistics of power stations or central stations as they are called. If the lamps begin to grow dim, which they do about their 400th hour of life, either new lamps or more volts must be employed. If a higher pressure is sent over the line, the power consumption becomes very much greater. For instance, with 1,000 lamps, each taking 50 watts 50,000 watts are required when the lamps are new, when they are old if the watts per lamp rise to 64, then 64,000 watts are necessary. The difference, 14,000 watts, represents enough cost in the way of coal, that service of this kind if continued becomes more expensive than lamp renewals. If the pressure is not raised, the lamps will burn very dimly and instead of the 16 cp. and 3 watt per candle consumption, there will be about 12 cp. and a 4 watt per candle consumption. Thus, the power of the plant will be devoted to the production of only 75 per cent. of the light, which is the worst possible practice. In this case, the general dissatisfaction as in the case of office buildings may be the cause of vacancies, which will make such economy a costly experiment.

The Wiring and the Amature.—The wiring may be correct according to the Underwriters' requirements and only have a 2 per cent. loss in volts. But in addition there is the armature to be considered. The armature conductors also cause a drop in volts when the load or current increases or diminishes; and the represent an electro-magnetic influence which opposes the magnetic field they revolve in, reducing it and thus cutting down the volts. Thus, it may be said that the regulation of a shunt or compound wound dynamo depends upon the


1
DIRECTION OF THE OPPOSING FIELD OF THE ARMATURE
DIRECTION OF THE MAGNETIC FIELD OF THE ARMATURE
N
S
2
3
+
-
NEUTRAL
+
-
-
N
+

1—Cutting down of the Dynamo Field by the Armature. 2—Three wires incased in conduit for subway use. 3—Two Dynamos connected up for the Three-wire System.

1—Drop in the armature conductors.

2—Reverse magnetic field in the armature conductors.

3—Drop in the wiring.

A recapitulation of the facts now clearly shows, that in incandescent lighting by direct current, by means of shunt or compound wound dynamos, the candle power produced and the efficiency of the lighting, depend upon the quality of design exhibited by the dynamo, the attention paid to drop in the wiring and the watts per candle power of the lamps.

The Two and Three Wire System.—The streets of New York are networks of copper wire incased in tubes or conduits. These wires compose a gigantic 3 wire system of conductors which is continued in every house which draws its power for lighting from this source. The two wire system is a simple extension of the idea of using 2 wires, between which are supplied by means of a variety of branches of 2 wires each all the lamps to be lighted. The 3 wire system dispenses with one wire, connecting dynamos of 110 volts pressure, between the outer and middle wires. The + pole of one dynamo is connected to an outer wire and the — pole to the middle wire. The — pole of one dynamo is connected to the other outer wire and the + pole to the middle wire. This gives two dynamos in series, with one wire emanating from the common or neutral pole called the neutral wire. The other two wires, one on each side of it, are respectively the + and — wires. They are also called the outer legs of the system.

OXYGEN AND HYDROGEN BY ELECTROLYSIS.

BY EMILE GUARINI.

As the number of the various applications of oxygen and hydrogen gas continue to increase, the greater become the efforts of inventors to produce these gases economically.

The principal application of these gases in the arts is the production of high temperatures for various purposes, such as the melting of platinum and other metals, and alloys, which have a high fusion temperature, for producing the Drumont light, for working hard and soft solders, and especially for soldering lead in sulphuric acid works, and for brazing or welding copper and other such metals in watch-making, and in the manufacture of jewelry and instruments of precision. While lately it has commenced to be used for producing the oxy-hydrogen flame for brazing aluminum, iron and for the partial annealing of armor plates.

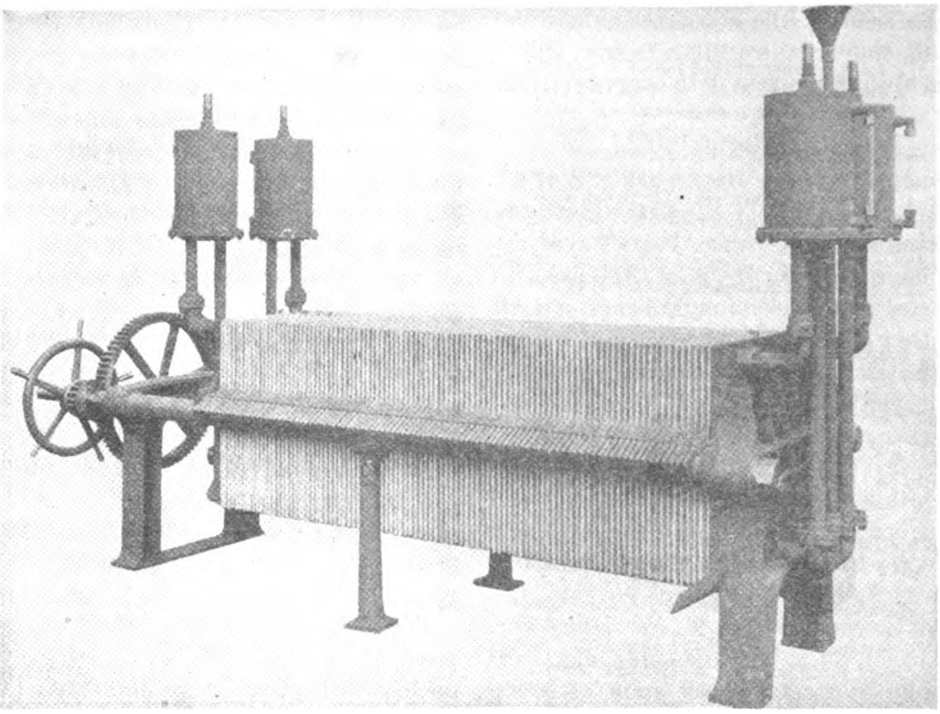
Oxygen alone finds many applications in chemical and metallurgical industries, in the manufacture and refining of steel, for laboratory and for medical purposes; while hydrogen by itself is used for inflating balloons and for incandescent gas lighting.

The oxy-hydrogen flame has an advantage over the electric arc, of being readily and easily regulated, and in not being colored, for it is possible to govern the admission of the gas in such a way as to obtain an oxidizing or reducing flame.

The powerful calorific effects of the flame permit of its being quickly used for soldering pieces of large dimensions, with hard solder. This process is very readily adaptable to the quick joining of those points which have failed to be welded by firing, without having need to submit the entire piece to a refiring, which would effect all the parts that had previously been welded, for the blow-pipe flame is able, without difficulty, to reach those parts not readily accessible.

We are able to obtain oxygen and hydrogen gas by the electrolytic method, and hydrogen produced by electrolysis costs but very little per cubic meter, or about 2 cents under the most unfavorable conditions, while its production by means of the action of sulphuric acid or zinc or on iron, would cost at a minimum 50 cents, while oxygen produced by the same method costs no more, and the electrolytic method of production will remain the cheapest until it becomes possible to economically produce oxygen from the atmosphere.

The Oerlikon electrolyzers are composed of a certain number of successive compartments, containing cast plate electrodes. The apparatus very much resembles that of a filter press. The insulation of the various plates is secured by resistant diaphragms, which at the same time keep the compartments perfectly water and gas tight. The gases are produced at the surface of the electrodes and escape through holes pierced through the plates. These holes communicate with two longitudinal pipes which convey the gases toward the separators, where the gases and the liquid are separated from each other; the electrolyte is conveyed back through a single pipe to the compartments, while the formation of the gases due to the passage of the current keeps up a continuous circulation of the electrolyte.



The Oerlikon Electrolyzer.

The cost of producing these gases by the Oerlikon apparatus is surely very low; 12 kilowatt hours is wholly sufficient to produce 1 cubic meter of oxygen and 2 cubic meters of hydrogen. Consequently, the cost of producing the gases will principally depend on the cost of the electric energy used, as the first cost of the apparatus and the interest on the investment are negligible quantities when compared with the quantity of the gases produced per annum.

The cost for current will vary according to circumstances from one-fifth of a cent per kilowatt hour, where economic hydraulic power is available, to 6 cents or more in small installations where steam power is used. Allowing an average price of 1 cent per kilowatt hour, the following cost prices are obtained:

1 cubic meter of oxygen + 2 cubic meters of hydrogen.....	12 cents
1 cubic meter of hydrogen + ½ cubic meter of oxygen.......	6 cents
1 cubic meter mixed....	4 cents

The oxygen produced by this method is at least 97 per cent. pure, the impurity consisting of hydrogen mixed with a small quantity of protoxide of carbon. The hydrogen is 99 per cent. plus 1 per cent. of oxygen. A simple device allows of both gases being obtained quite pure.

These electrolyzers decompose 134 grams of water per kilowatt hour in producing 168 liters of hydrogen and 84 liters of oxygen. The output of the apparatus when warm amounts to 8 per cent., and these electrolyzers will readily carry a temporary overload of 25 per cent.

The usual construction of these Oerlikon electrolyzers allow of the gases being produced at a constant pressure, which may attain an equivalent of 2½ meters of water.

The electrolyte consists of a solution of 10 per cent. of carbonate of potash in distilled water, and it undergoes no chemical change under the action of the current. The decomposed water is replaced by distilled water.

The simple construction of this apparatus allows of its being very quickly cleaned, and when it is operated continuously this is only necessary about every eight weeks, and no other attendance is required except to replace the water as it is decomposed.

The electrolyzer when cold requires about 2.7 volts per compartment, and when it is warmed up a current of 2.3 volts is all that is required. The maximum temperature of about 60 per cent. Centigrade, is obtained after the apparatus has been in operation eight hours.

The advantages of the Oerlikon electrolyzers may be summed up as follows: Simplicity of construction, ease of operation and low cost of maintenance. As may be seen by the accompanying illustration, they require little space, which is not always the case with other systems.

Animal Electricity.

A dispatch to the New York "World" from San Francisco, Cal., states that tests covering a period of two years have just been completed by Dr. A. J. Atkins, who believes that the brain and heart and all the other organs of the physical structure are electrical machines, depending wholly upon electromotive force for their activity.

The last of the series of experiments by which this theory is claimed to have been scientifically proved was conducted last week in a South San Francisco stockyard, when Dr. Atkins and his co-workers, Dr. E. A. Lewis and Dr. H. W. Hunsaker, registered on a galvanometer electrical currents in the heart and brain of living sheep. Tiny electrodes attached to the testing instrument by a long wire were inserted directly into the heart and brain of the animal that had been prepared for vivisection by the injection of cocaine into the spinal column, and instantly, as the sharp points pierced these vital organs, the needle of the delicate machine quivered and oscillated as it registered in millivolts the alternating currents of electricity.

If Dr. Atkins is right in what he believes he has proved, man and his lower kindred, the animals, are complicated electrical machines with a lot of smaller machines within the large one.

Dr. Atkins as far back as last September registered electrical currents in the lungs of a sheep, and later demonstrated in the same way that the liver, kidneys and other organs are also run by electricity. The lungs contain by far the most positive electric energy. This, Dr. Atkins explains, is because the oxygen drawn in the lungs is chemically combined with the blood in this organ. This is done by electro-chemical action, according to Dr. Atkins. Chemical action is nothing but electrical action, he argues, and in the lungs begins the process of generating the electricity with which the body is stored, and which, in fact, is the life of the body.

ESTIMATED COST OF MUNICIPAL LIGHTING.

At a meeting of the Board of Estimate of the City of New York on February 10 Mayor McClellan presented the preliminary report of the commission he appointed to prepare plans for municipal lighting plants. The members of the commission are Cary T. Hutchinson, George F. Sever and Nelson P. Lewis. The report is an elaborate one, but deals only with plants for lighting the streets, parks and public buildings.

The estimated cost of complete plants for providing 6,000 electric arc lamps and 250,000 sixteen candle-power incandescent lights is $4,100,000, exclusive of the cost of real estate. The commissioners in their report say that they have decided on two sites for power houses, but the locations are not made public. They ask permission to consult privately with the Comptroller in order that they may obtain options on the land. The Board of Estimate ordered the report in full printed and requested the Comptroller to confer with the committee about the purchase of sites for power houses.

The report says that the total cost of a power station with 10,000 kilowatts power, exclusive of real estate, will be $1,250,000, and the cost of high pressure cables, substations and all details for 6,000 arc lights and 250,000 sixteen candle-power incandescent lights, $2,850,000.

The estimated cost a year of arc lamps, including interest on bonds and depreciation of plant, is placed at $75.40. The cost a year of the sixteen candle-power incandescent lights is fixed at $5.15. The total annual cost of operating the proposed plants is estimated in the report at $906,000. The estimates do not include any cost for the construction of ducts or rental for them, because the city has the right to use the ducts of the private subway companies.

The general plan suggested in the report provides for a power station for Manhattan and the Bronx, one for Brooklyn and Queens and a third for Richmond. There is no reference to extending the system to provide light for private consumers.

According to the report the estimated cost of lights is less than the city is now asked to pay to private companies. The present cost of arc lights is from $130 to $145 a year, and the Commission's estimate of the cost by a city plant is $75.40. The average cost of street lamps is now $16 a year, while the Commission's estimate of the cost to the city of sixteen candle-power incandescent lights is $5.15 each.

THE INSTITUTE DINNER.

The annual dinner of the American Institute of Electrical Engineers was held in the grand ball-room of the Waldorf Astoria, New York City, on the evening of February 8. The room was appropriately decorated for the occasion. Miniature electric lamps were everywhere in evidence and numerous Cooper Hewitt mercury vapor lamps were placed around the balcony.

The members and guests numbering about 300, met in the Astor gallery, where the famous painting of Dr. Gilbert, and a beautiful bust of Galileo Ferraris were inspected.

The dinner was served promptly at 7:30. Toward the close President John W. Lieb, Jr., greeted the guests in the name of the Institute, and took occasion to make a few apt remarks on the progress made in the industry.

Mr. T. C. Martin was introduced and acted as toastmaster.

Mr. Frank J. Sprague was then called upon and responded to the toast of "Art and the Men." He reviewed the struggles in the early days of the electrical industry and among other things said:

"Looking back these nearly twenty years, I am reminded of the cry of the prophet, 'Oh, ye of little faith,' and yet I for one, and I think I may speak for most of the others, would not have had it otherwise, for let me tell you, my younger brethren, whether it be on the battle field or in civil pursuits, there is no victory so sweet as that wrung from almost certain defeat, and if you need encouragement in present or future struggles, let me bid you ask of the living and the dead the record of 1879 to 1888. They will tell you of cynicism, ridicule and unbelief, of unremitting labor and disappointment, of poverty, sickness, wreck and ruin, but they will also tell you of their inspirations, of exalted moments, of hopes realized, of victories won."

Mr. Leo Daft followed Mr. Sprague, his address being "These Twenty Years."

Mr. Herbert H. Vreeland responded to he toast of "The Broomstick Train."

Mr. Lewis Buckley Stillwell, in his address, entitled "Traction Above Ground nd Under," said:

"As a public work the construction of the New York Subway has been an object lesson of great significance and value. From start to finish it has been carried out under the direction of the Rapid Transit Commission, without fear or favor, and with an eye single to the public good. No money has been wasted and not the slightest scandal of any kind has attended its progress. The work is a splendid monument to the Commission and to its engineers. The community has received maximum benefit at minimum cost. At the same time the enterprising men who ventured their capital in the enterprise, at a time when its success was generally considered doubtful, have reaped a handsome reward to which they are in every sense of the word entitled."

The toast on "Other Uses of Electricity," was responded to by Gen. A. W. Greeley. He spoke interestingly of the work that had been and was being done by the United States Army Signal Corps.

The following gentlemen were seated at the speaker's table. John W. Lieb, Jr., T. C. Martin, F. J. Sprague, L. B. Stillwell, C. A. Coffin, C. C. Schneider, W. G. Ross, James Gayley, Nikola Tesla, Elmer A. Sperry, General Greeley, Leo Daft, C. F. Scott, R. W. Pope, Gen. Eugene Griffin, E. W. Winter, H. H. Vreeland, T. C. MacCarter, Dr. A. R. Ledoux, Dr. F. B. Crocker, W. B. Potter, C. G. Curtis, W. J. Wilgus, F. D. Underwood, H. H. Westinghouse, Dr. S. S. Wheeler, G. W. Stockley, John R. Freeman, H. Ward Leonard and B. J. Arnold.

New York Electrical Society.

The 248th meeting of the Society will be held in the Assembly Room of the Metropolitan Street Railway Association, 761 Seventh avenue, this (Wednesday) evening, February 15, at 8 o'clock. The room is on 50th street, one block east from the Subway station, and one block west from the 6th avenue elevated station. Mr. Herbert H. Vreeland, president of the New York City Railway Company, will address the Society on "Electric Railway Operation in a Great City."

on's 58th Birthday.

Mr. Thomas A. Edison celebrated his 58th birthday Saturday in his Orange, N. J., home. Mr. Edison's progress toward recovery is steady, but his family and his physician are shielding him from all excitement.

Central Electric's Building Burned.

A six-story brick building at Nos. 264-270 Fifth avenue, Chicago, occupied by the Central Electric Company, was practically destroyed by fire on Saturday, causing a loss of $600,000.

Proposals Invited.

The Bureau of Supplies and Accounts of the Navy Department at Washington, D. C., is inviting sealed proposals until March 14 for furnishing the Mare Island and Puget Sound Navy Yards with the following: Schedule 79, insulating tape, electrical wire, transformers; schedule 82, incandescent lamps, electrical cable, tape and globes. Blank proposals will be furnished on application to the Bureau or to the navy pay offices in San Francisco, Cal., and Seattle, Wash.

On March 3 the supervising architect of the Treasury Department will open bids for the installation of a conduit and electric wiring system in the United States Marine Hospital at Savannah, Ga. For further information address James Knox Taylor, supervising architect, Washington, D. C.

Sealed proposals for installing electric elevators in the new quartermaster's storehouse at Omaha, Neb., will be received until February 28. Full information furnished on application to Lieut.-Col. J. E. Sawyer, Omaha, Neb.

Sealed proposals for installing two electric elevators in the Portsmouth, N. H., Navy Yard, will be received until March 11. Plans and specifications may be seen at the office of the commandant of the yard, or at the Bureau of Yards and Docks, Navy Department, Washington, D. C.

Wants a Second-hand Engine and Boiler.

We are in receipt of the following: "In a copy of ELECTRICITY I noticed several advertisements of machinery, and being in the market for an engine and boiler, large enough and qualified to run a 30 kw. dynamo, can you give me the address of a place where I can get a second-hand engine and boiler? E. M. Hanscom, Milton, Fla."

Standard Underground Cable Company's St. Louis Office.

The Standard Underground Cable Company, owing to general developments in its rapidly growing business in the southern and southwestern territory, has decided to establish in St. Louis its southwestern sales office. Mr. E. J. Pietzcker, who has been attached to the Western Sales Department with headquarters in Chicago for the past two years, has been appointed manager of the new sales office and will be located at 521 Security Building, St. Louis.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED FEB 7, 1905.

Electric Railways and Appliances.

781,639. Railway-Signal. Frank L. Dodgson, Rochester, N. Y., assignor, by mesne assignments, to the General Railway Signal Company, Gates, N.Y. Filed March 27, 1903.

781,661. Stringer-Support for Electric Third Rails. Frank E. Kinsman, Plainfield. N. J. Filed July 28, 1903.

781,721. Guard for Trolley-Wheels. Merwin M. Hart, Chicago, Ill. Filed April 15, 1904.

781,757. Automatic System of Signaling for Electric Railways. Samuel M. Young, New York City. Filed Nov. 15, 1904.

781,842. Multiple-Contact Trolley. Lewis M. McBride Denver, Col. Filed July 5, 1904.

781,962. Trolley. Edward H. Miller, Pittsburg, Pa., assignor of one-half to Harry Carr, Harry E. Weaver and Louis H. Rosenthal, same place. Filed Sept. 30, 1904.

781,991. Car-Fender. Louis A. Bechtel, Jr., Benwood, W. Va. Filed Sept. 23, 1904.

782,007. Third Rail. Leonard T. Crabtree, Crandon, Wis. Filed April 14, 1904.

782,100. Signaling Apparatus for Electric Railways. Walter C. Bethel, Seattle, Wash. Filed Nov. 4, 1904.

782,195. Trolley-Pole Controller. Clarence V. Greenamyer, Los Angeles, Cal., assignor to William Hyman Holabird, same place. Filed Feb. 4, 1903.

Electric Lights and Appliances.

781,937. Electric-Arc Lamp. Albert G. Davis and John E. Hubbell, Schenectady, N. Y., assignors to the General Electric Company. Filed July 7, 1904.

Electrical Machinery and Apparatus.

781,638. Electric Ingot-Extractor. James R. Spear and Willie H. Baltzell, Pittsburg, Pa. Filed May 17, 1900.

781,706. Alternating-Current Generator. Emil Ziehl, Berlin, Germany. Filed Sept. 30, 1904.

781,785. Circuit-Controller. Louis Pfingst, Boston, Mass., assignor to Pfingst Electric Manufacturing Company, Kittery, Me. Filed April 4, 1904.

781,931. Means for Protection Against Short Circuits. Charles E. Barry, Schenectady, N. Y., assignor to the General Electric Company. Filed July 15, 1904.

781,932. Alternating-Current Apparatus. Edward Bennett, Pittsburg, Pa., assignor to George Westinghouse, same place. Filed Oct. 13, 1902.

781,945. Electric Meter. Edward S. Halsey, Chicago, Ill., assignor to the General Electric Company. Filed March 13, 1902.

781,968. Dynamo-Electric Machine. Joseph Sachs, Hartford. Conn. Filed Sept. 19, 1903.

781,989. Controlling Mechanism for Self-Propelled Vehicles. Augustus A. Ball, Jr., Lynn, Mass., assignor to the General Electric Company. Filed Sept. 4, 1902.

781,993. Circuit-Closer. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, same place. Filed Oct. 9, 1903.

782,082. Coin-Freed Electric Meter. Frank Holden, Rugby, Eng., assignor to the General Electric Company. Filed March 3, 1903.

782,038. Thermal Cut-out. Charles E. Lockwood and George A. Lutz, New York City. Filed Oct. 28, 1903.

782,054. Induction-Motor. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company. Filed July 11, 1904.

Telephones and Telephone Apparatus.

781,793. Sanitary Attachment for Telephones. Isaac M. Slocum, Boston, Mass. Filed June 22, 1904.

781,797. Telephone-Receiver. Axel R. Thollander, Chicago, Ill. Filed Oct. 1, 1904.

781,888. Telephony. Isidor Kitsee, Philadelphia, Pa. Filed April 4, 1901.

Miscellaneous.

781,762. Electrical Dental Furnace. Luther L. Bosworth, Cleveland, O. Filed March 5, 1904.

781,795. Storage-Battery Electrode. Elmer A. Sperry, Cleveland, O., assignor to the National Battery Company, Buffalo, N. Y. Filed Jan 27, 1904.

781,805. System of Electrical Distribution. Theodore Bodde, Schenectady, N. Y. Filed Nov. 18, 1903.

781,873. Wireless Telegraphy. Patrick B. Delany, South Orange, N. J. Filed July 10, 1903.

781,919. System of Electrical Distribution. Charles W. Stone, Schenectady, N. Y., assignor to General Electric Company. Filed Sept. 30, 1901.

782,066. omatic Alarm-Telegraph. Albert D. Shaw, New York City. Filed April 15, 1904.

782,131. Electric Temperature-Alarm. Cowan P. Heple Smithton, Pa. Filed Feb. 20, 1904.

THE TELEPHONE WORLD.

Buffalo Independents Meet.

The February meeting of the Buffalo district of the New York State Independent Telephone Association was held in that city about ten days ago. Practically all of the Independent telephone companies operating in the district were represented.

The growth and financial success of the Independent telephone companies in that district is said to be flattering to the organizers, and much new construction is planned for the coming year.

Telephone Improvements in Wisconsin.

A large amount of construction work will be done on Independent long-distance telephone lines in Wisconsin and the Northwest the coming summer, according to a statement made by Manager Bowee of the Consolidated Company of Minneapolis.

Mr. Bowee stated that his company built 600 miles of new line last summer, including the line to Winona and La Crosse, and expects to push on to Madison and other cities in the State the coming season.

The New York Telephone Company has announced a general reduction of 25 per cent. on all its charges for service to the various departments of the municipal goverment. The cut rate takes effect from January 1, 1905, on all city contracts, both for unlimited and measured rate service. No new concession has been made yet to private subscribers, the 25 per cent. reduction applying only to telephone installations in connection with the various branches of the city's official business.

The Southwestern Home Telephone Company of Redlands, Cal., has filed articles of incorporation in San Bernardino. The company will build a line from Redlands, Beaumont, Banning, San Jacinto and Hemet, and thence along the line of the Southern Pacific to Yuma, Ariz. The work of constructing this line is already under way and when completed will be the only telephone line from California to connect with the Arizona lines.

The Georgia-Alabama Telephone Company, which operates the Dawson telephone exchange, is making extensive improvements in the system. In consequence of these improvements the rates are to be increased from $1.50 to $2 per month for residence 'phones, and from $2.50 to $3 for business houses and offices.

A report from Philadelphia states that the Keystone Telephone Company reorganization plan is said to be about completed and provides for a new bond issue to take the place of the present bonds and preferred stock.

The Long Distance Telephone Company of Kansas City has filed a mortgage in Nevada City, Mo., for $1,500,000 to the Commonwealth Trust Company. The company is building a line from Joplin to Kansas City.

The Michigan State Telephone Company is at work on the construction of a telephone line from Escanaba to Foster City, a distance of 40 miles.

Another Independent Telephone Association Organized.

The West Kentucky and Tennessee Independent Telephone Association was lately organized at Hazel, Ky.

The association consists of seven Independent telephone companies, with a total of 320 miles of lines. They are as follows: The Citizens, the Marshall County, the Calloway County, the Lily, the Valley and the Farmers' and the Rural Telephone Company. All of these companies were represented by delegates at the meeting and have made arrangements to extend their lines all over the country. Their lines now reach Sedalia and in a short time will enter Mayfield, where the stockholders of the company will have free communication over the entire system. Capable and reliable business men are at the head of this new association. Dr. W. B. Stokes is the president, B. B. Pullen secretary, and J. V. Boyd treasurer, all of Farmington, besides many other good business men are stockholders.

After many weeks of preparation the Livingston County Telephone Company has now completed its exchange in Geneseo, N. Y. The company has spared no pains in installing the office equipments, and the thoroughness of the work indicates that the Geneseo exchange will not lack for business. The sharp competition which is already noticeable between the branch of the Bell Company there and the County Telephone Company bids fair to make the service better than any that has heretofore been given.

At a meeting of the stockholders of the County Telephone Company of Herkimer, N.Y., recently the following were elected officers: President, Robert Earl; vice-president, James Conkling; secretary, Charles H. Poole; treasurer, W. I. Taber; engineer, Edward Cline. The company has 'phones in Ilion, Frankfort, Mohawk and Herkimer.

The Yellville Telephone Company of Yellville, Marion County, Ark., was lately given a charter. The capital stock is $150,000, all subscribed, and the company has announced its intention of constructing and operating telephone plants in several of the towns of Marion, Boone and Baxter Counties. The incorporators are V H. Weart, L. M. Weart, S. L. Brooksher, R. R. Brooksher and G. A. Ward.

The Caddo Cave Telephone Company, with a capital stock of $20,000, has been incorporated to build telephone lines in Montgomery and Garland Counties, Ark. The place of business is at Johnson, but the office of the company is at Ghent. The incorporators are J. Johnson, G. A. Driggins, F. J. Hughes, J. L. Thomas and J. A. Johnson.

At a meeting of the stockholders of the Camden, Mich., Rural Telephone Company the capital stock of the company was increased to $25,000. This company was incorporated about 18 months ago.

The annual convention of the Ohio Independent Telephone Association will be held in Columbus some time next month. Frank L. Beam, of Columbus, is president of the association.

Iowa's Telephone Record.

According to the United States Census Bureau's Bulletin, covering the development of the telephone business up to the close of 1902, Iowa is shown to have the largest growth in the matter of rural lines, having an average of 13.6 miles of wire and 20 telephones for each rural line.

It has 33 per cent. of all the Independent rurul lines of the country, which use 25 per cent. of the total mileage of wire needed for such telephones.

The total number of lines operated in rural districts is given as 21,577. Of this number 15,598, or 73 per cent., were lines owned and operated by commercial systems; 994, or 4.6 per cent., were the mutual systems, all of which are rural, and the remaining 4,985, or 23 1 per cent., were Independent farmer or rural lines. The total length of wire is given as 259,306 miles, and the total number of telephones 266,968, giving an average of about 12 telephones to each line and less than one mile of wire per telephone. Five States, among which was Iowa, have 68.9 per cent of all these lines.

Iowa is shown to have 120,017 telephones of all kinds, which is one to every 19 residents of the State.

Farmers of Belle Township, Edmunds County, S D., have organized the Edmunds County Mutual Telephone Company. They have a barbed wire telephone system of twelve miles, and by co-operation hope to extend the system and to fill in any gaps that may exist in neighboring communication.

The Kansas Independent Telephone Association held its annual meeting in Topeka February 8 and 9. The officers of the association are: President, A. A. Godard, Topeka; vice-president, J. M. Doyle, Belleville; treasurer, J. W. Smith, Minneapolis; secretary, C. E. Wells, Marion.

The farmers in the neighborhood of Maize, Kan., are desirous of installing a telephone system for their own use, to be connected with the system in Wichita. To that end they want a franchise for a central office and switchboard, to be located at the latter place.

Telephone Incorporations.

The West Richfield Telephone Company, West Richfield, O. Capital stock, $10,000. Incorporators: Edwin L. Carter, James B. Stauffer, J. B. Kennedy, M. L. Newton and Allen S Prickett.

The Santa Clara Valley Home Telephone Company. Capital stock, $75,000. Directors: C. F. Guthridge, C. L. Zahn, D. F. Boyce, C. P. Platt and A. Wright, all of Los Angeles.

The American Rural Telephone Company, Apache, Okla. Capital stock, $10,000. Incorporators: J. H. Mallory, L. Beckman and R. N. Mallory.

The Home Telephone Company, Grand Meadow, Minn. Capital stock, $50,000. Incorporators: C. F. Greening, W. A. Nolan, Martin Axness and W. P. Lewis, all of Grand Meadow.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Albany, N. Y.—The Franklin Springs Electric Light Company, with a capital of $5,000, has been incorporated by Frederic De W. Smythe and Delos De W. Smythe, of Utica, and E. B. Stanley, of Clinton, to operate in the towns of Kirkland, New Hartford and Marshall and the village of Clinton.

Clear Lake, Minn. —This city is negotiating for an electric light plant.

Elko, Nev.—The Elko Electric Light & Power Company has been incorporated by John G. Hylton, A. W. Hesson, R. H. Mallett and others with a capital of $100,000.

Goodwater, Ala.—Arthur Salmon, of Dadeville, has secured a franchise to construct an electric light plant here.

Harrison, O.—A. L. Rich & Co. have increased the capital of the Harrison Waterworks & Electric Light Company to $40,000. Improvements are contemplated.

Keyser, W. Va.—The Keyser Electric Light Company contemplates enlarging its plant. F. M. Reynolds is president.

Lacrosse, Kan.—This city has under consideration the voting of bonds to the amount of $25,000 for the purpose of establishing a waterworks and electric light plant.

Lawrenceburg, Ky.—The committee appointed by the Commercial Club believes that a contract will soon be made which will insure the installation of an electric light plant within the next few months.

Lexington, Mo.—Charles Reynolds, C. B. Leach and E. H. Burr have incorporated the Lexington Gas & Electric Company with a capital of $80,000.

Liberty, Mo.—The electric light plant was lately wrecked by the explosion of a boiler.

Loveland, O.—The people of this city are trying to secure an electric light plant.

Lytton, Ia.—A plan is on foot for the lighting of this place from the electric plant at Sac City.

Madison, Mo.—Local capitalists are agitating a project to operate an electric light plant here.

Memphis, Tenn.—The Merchants' Light & Power Company, capitalized at $500,000, has been incorporated by L. Bry of St. Louis, Hugh Pettit and R. W. Uhlman to erect an electric light plant.

Meridian, Miss.—A franchise has been applied for by C. H. Dabbs, R. Cahn, H. L. McKee and J. T. Chalk to build and operate an electric light and gas plant.

Montrose, S. D.—Mark Donahue and P. G. Williams have purchased an electric light plant which will be installed as rapidly as possible.

Niles, O.—The city electric lighting system is inadequate and the purchase of a new engine is necessary.

Oakdale, Pa.—The electric lighting plant was recently destroyed by fire. Loss, $5,000.

Palmyra, N.Y.—The Palmyra Gas & Electric Company has been incorporated with a capital of $25,000.

Plaquemine, La.—The Plaquemine Electric Light & Power Company, with a capital of $30,000, has been incorporated by H. J. Savage, M. Dick and V. M. Barber, and proposes to erect a system of electric lights for this town.

Rochelle, La.—The electric light plant, ice factory and machine shops owned by the Louisiana Lumber Company were lately destroyed by fire.

Royalton, Minn.—It is the intention of the council to at once commence the installation of an electric light plant.

San Angelo, Tex.—U. G. Taylor of this place expects to install at an early date an electric light plant at Angelo Heights.

San Jose, Cal.—A committee of the assembly on public buildings and grounds came here recently and proceeded to Mount Hamilton for the purpose of looking into the need of an electric lighting system at Lick Observatory and whatever else is needed. A bill for an appropriation of $10,000 for this purpose has been introduced by Assemblyman Paul J. Arnerich. It is not known whether the proposal will be to establish a plant on the mountain or to connect the system that may be installed there with the Blue Lakes system.

Seminary, Miss.—The Mason Lumber Company, whose plant is located at Pratt Station, half a mile north of here, will put in a large electric lighting plant at an early date and furnish lights for this place.

Spearfish, S. D.—The Homestake Mining Company has purchased the Spearfish Electric Light & Power Company's property which furnishes light and heat for this city.

St. Louis, Mo.—The North American Company will expend $2,000,000 on improvements to the plant of the Union Electric Light & Power Company.

Wauette, Okla.—Captain Hamblin and Phil Hall of Shawnee, I. T., capitalist and promoter, have been looking over the ground here for the purpose of securing a franchise for an electric light plant and waterworks system. They have met with much encouragement.

Watkins, N. Y.—The electric light plant of the Watkins Consolidated Gas & Electric Light Company was destroyed by fire. The loss is covered by insurance.

STREET RAILWAYS.

Baltimore, Md.—The United Railways & Electric Companies will erect a power house on Pratt street to cost $75,000. John Walters is the contractor.

Boise, Idaho.—W. E. Pierce states that the local company which is being formed for the purpose of building an electric railroad from here to Pearl means business and that the work of surveying for the line will be commenced as soon as the weather will permit.

Clarksville, Tenn.—The Clarksville Electric Street Railway Company has filed an amendment to its charter changing its name to the Clarksville Railway & Light Company, and increasing its stock from $20,000 to $250,000. The amendment authorizes the extension of its lines to the Kentucky State Line, New Providence, Durbars Cave and other places.

Clyde, N. Y.—Outside capitalists having promised to build an electric road between here and Sodus Bay to cost approximately $250,000, providing the people of this section would subscribe for $20,000 worth of the stock, at $100 a share, an effort is being made to meet these requirements.

Corry, Pa.—A trolley line will be run from this city to Columbus, O.

Des Moines, Ia.—J. W. Blesee and several men of this city have a project for building an electric road from here to Kansas City, Mo., via Winterset Greenfield, Carbon and Villisca.

Joplin, Mo.—The Spring River Power Company of this city announces that it will build an elctric line from Baxter Springs to Galena, a distance of eight miles. Most of the right-of-way has been secured, and work of laying the rails will begin at once. The line will connect at Galena with the Southwest Missouri electric railway.

Kennett Square, Pa.—A new trolley line from here to Coatesville, 13 miles, is projected.

Lafayette, Ind.—The Lake Erie & Western Railroad Company has decided to start the work of electrifying a number of its lines in this State. The company expects to spend $200,000.

Noblesville, Ind.—The Indianapolis, Hartford City & Celina Traction Company has asked the city council for a 50-year franchise.

Paducah, Ky.—Jeff Read of this city is one of the promoters of a proposed electric interurban road between Paducah and Cairo, Ill.

St. Joseph, Mo.—A franchise has been granted to the St. Joseph & Maryville Electric Railroad Company, to build a line from Andrew to Buchanan Counties.

Texarkana, Ark.—The Texarkana Traction Company contemplates the erection of a boiler house and the installation of new machinery and boilers.

Warrenton, Va.—The people here are discussing a project to build a trolley line from Fauquier County to Deep Water on the Potomac River.

POWER PLANTS.

Durango, Mex.—Thomas Wilson has been investigating the situation in the western part of the State of Durango, with a view to establishing an electric power plant in that region for furnishing power for mines.

Oaxaca, Mex.—Charles A. Hamilton, who has been busily engaged on the project for the erection of a large smelter in this city, is now working on a plan for putting in a vast electric power plant in the district of Ejutla, in the State of Oaxaca.

San Cristobal, Mex.—John J. Moylan, a capitalist and mine operator of the City of Mexico, is preparing to establish an electric power plant near this place. The proposed plant will be located on the San Cristobal River and will afford power for operating hoists and other machinery at the Poder de Dios mine.

BIDS WANTED.

Columbia, Tenn.—George P. Webster represents a company of this city that is in the market for a 75 hp. Corliss engine.

Gum Neck, N. C.—F. F. Owens, Box 47, is in the market for a 10 hp. engine and 12 hp. boiler.

Havre de Grace, Md.—F. Schnitzlein of this city is in the market for a 12 hp. engine and a 40 hp. upright boiler.

Lawton, Okla.—The Lawton Ice Company will be in the market next June for electrical equipment.

Worcester, Mass.—The Worcester Electric Light Company is in the market for a new battery of 12 boilers, to aggregate 3,000 hp.

NOTES FOR INVESTCRS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15¼@15⅜c.; casting, 14⅞@15c.

In a circular issued on Boston Elevated, Hornblower & Weeks show that the average gain in the gross earnings of the system for the last ten years has been 6.1 per cent.

The American Railways Company (Philadelphia) declared a regular quarterly dividend of 1½ per cent. on the capital stock, payable March 15, to stockholders of record February 28.

The Southern New England Telephone Company has made application to the Connecticut General Assembly for permission to increase its capital stock from $5,000,000 to $10,000,000.

The report of the Interborough Rapid Transit Company of New York for last quarter showed increased net earnings due to the subway. The company's gross earnings for the three months increased $815,145.

The Philadelphia Rapid Transit Company has sold $10,000,000 bonds of the Market Street Elevated Railroad Company at par to Drexel & Co. The bonds bear 4 per cent. interest payable semi-annually and run 50 years.

The syndicate which took charge of the issue of Brooklyn Rapid Transit bonds has disposed of all the bonds. It is understood that the Brooklyn Rapid Transit Company will hereafter issue no bonds having the convertible clause.

The $7,500,000 bonds of the recently organized Baltimore Electric Power Company, which will probably absorb the Maryland Telephone Company, have been underwritten by the Northern Trust Company, of Philadelphia, and the Central Trust Company, of Maryland.

Suit has been instituted in the Court of Chancery at Trenton, N. J., to set aside two voting trusts of the Augusta-Aiken Railway & Electric Company which owns and operates the entire street railway and electric lighting systems of Augusta, Ga. The complaining stockholders charge a general mismanagement of the company's affairs.

It is stated at New Haven that negotiations for the purchase by the New Haven Railroad Company of the Connecticut Railway & Lighting property, consisting of 175 miles of single track and several gas and electric light companies, and capitalized at $9,464,100 common stock and $5,535,900 preferred, are still far from consummation.

The reorganization committee of the New Orleans Railways Company, of which Otto T. Bannard is chairman, has announced a plan of reorganization through the formation of a new company with $30,000,000 of 30-year 4½ per cent gold bonds, $10,000,000 of 5 per cent. non-cumulative preferred stock and $20,000,000 of common stock.

The Hamilton Gas & Electric Company is the name of the consolidation of the Hamilton Gas & Coke Company, the Hamilton Electric Light Company and the Hamilton-Otto Coke Company, all of Hamilton, O. The new company has made a mortgage to secure $1,000,000 five per cent. 30-year bonds and has a capital stock of $1,060,000

Stockholders of the Gas & Electric Company, of Bergen County, N. J., will vote February 23 on leasing the property for 999 years to the Public Service Corporation, which will guarantee dividends on $2,000,000 stock, 2 per cent. for two years, 2½ per cent. for one year, 3 per cent. for two years, 4 per cent. for four years and 5 per cent. thereafter.

ELECTRIOAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Noon price Feb. 14
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	174½
Metropolitan Street Railway	122¼
Metropolitan Securities	82
Ninth Avenue	197
Third Avenue	132¼
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	62¼
Interborough Rapid Transit	218
New Orleans Railway	4
Public Service Corporation (New Jersey)	141
Philadelphia.	
Consolidated Traction of New Jersey	82¼
Philadelphia Traction	100¼
Union Traction	58⅜
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	15¼
do. do. do. pref.	59½
West End Street, com	96
do. do. do. pref.	115
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	12⅞
do. do. pref.	51
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	15¾
do. pref.	73¾
Electric Boat, com	42
do. do. pref.	82
Electric Lead Reduction	¼
Electric Vehicle, com	16
do. do. pref.	25
Westinghouse, com	180
do. pref.	192
General Electric	186
Boston.	
Edison Electric Illuminating	251
General Electric	186
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	155
National Carbon, com	42¼
do. do. pref.	114½
Philadelphia.	
Electric Company of America	10¾
Electric Storage Battery, com	78
do. do. do. pref.	78
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	144
Western Telephone Company	22
New England Telephone Company	189½
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210¼
Mexican Telephone Company	1
New York & New Jersey Telephone Company	158¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92¾
Chicago Telephone Company	140
MISCELLANEOUS STOCKS.	
Otis Elevator Company	49
Consolidated Car Heating	64
Standard Underground Cable	200

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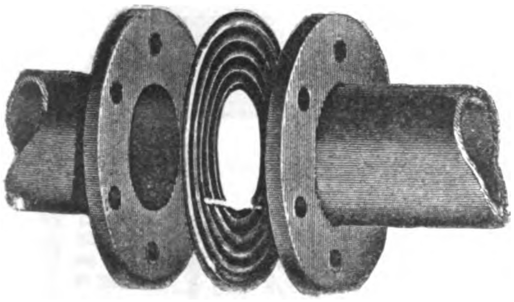

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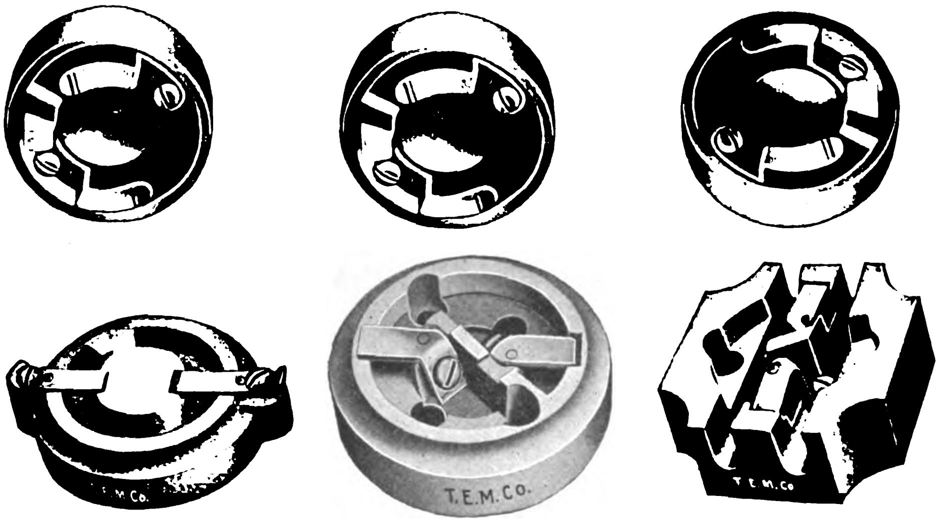

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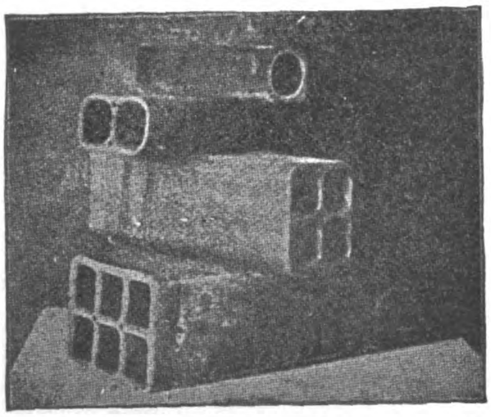

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ELECTRICITY.

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EDITORIAL NOTES.

The Tantalum Lamp.

Inventors and scientists, especially in Germany, are constantly at work trying to perfect the incandescent electric lamp. And sad to relate, although the incandescent lamp with carbon filament, as seen to-day, is a work of genius, it can stand perfecting in the way of heat loss and length of life.

Elsewhere in this issue will be found a short article on a new lamp recently brought out in Germany. In this lamp the carbon filament has been discarded and instead a filament of the metal tantalum is made use of. This filament is over two feet in length and is supported by a special form of frame and bulb, the extremities of the filament being connected with the foot of the lamp by means of platinum strips.

Referring to the subject the "Mechanical World," an English publication, states that experiments show that the tantalum lamp consumes about 50 per cent. less current at the same voltage, with the same intensity of light and the same useful life, that the carbon filament lamp does. The useful life of the lamp averages between 400 and 600 hours at 1.7 watts per British candle-power, while under normal working conditions the average life ranges from 800 to 1,000 hours.

* * *

Avoid Socialistic Tendencies.

The bids for building the garbage destructor plant, which is expected to furnish electric light for the Williamsburg Bridge and neighboring school-houses, were opened last week. The lowest bid submitted was $31,000. This bid is for the buildings, but does not include the necessary electrical machinery and apparatus.

The question as to the advisability of the city owning and operating its own plants is still being warmly discussed pro and con. A few days ago the "Wall Street Summary" referred to the question editorially: It said:

"We have our doubts, as to the wisdom of the action taken; and believe that all this agitation and public clamor will soon die out and that a rational view will be taken of the subject. We are yet to be convinced that municipal ownership in a city like ours is wise or prudent. The principle involved may be popular, but the practicability of the policy is unquestionably very doubtful. We do not believe it is possible for the city to operate any public electric or gas plant, and eliminate therefrom political methods and partisan manipulation. We feel that places will be created, and that the demand for sinecures will be so strong, that in a short time the operation of this public utility will become a hot bed of pernicious political activity. When that time arrives, as it surely will, the present sentiment, so strongly in favor of the step taken, will change to a demand for a return to private ownership. If it were possible to establish safeguards which would insure business methods in the operation by the city, of its public lighting plants, then the step just taken would be in the right direction. As that is not probable, or will not be done, then we are not disposed to become enthusiastic over the apparent possibilities now in sight."

The above opinion agrees with that expressed by us in these columns only two weeks ago. The "Wall Street Summary" believes that the real remedy consists in curbing by means of proper legislation the private corporations now furnishing light, for it concludes as follows:

"Legislation to curb those who may

take undue advantage of the franchises they possess, is one thing; but to jump from the 'frying pan into the fire' is another. We know it is possible to safeguard our city against the wrongs that may be done by corporations, and to that possibility and necessity our public officials should direct their attention rather than to the opportunity of 'tickling the fancy' of those who possess socialistic tendencies, and toward providing political 'pap' and 'graft' to the hungry horde who are constantly watching and waiting for something to 'drop into their laps.' The authorities may be sincere; but they surely are not acting wisely. When so much is involved, and millions are to be expended, action on impulse, though prompted by public clamor, becomes a criminal offense."

* * *

Radium Research. Hardly a day passes without something new being added to our information in regard to radium. The very nature and state of our knowledge concerning it are sufficient to account for this, seeing that the leading scientific minds in all countries are engaged in the investigation of this, the most fascinating of all scientific matters of the hour. But it is not only the leaders in scientific circles who are engaged in this research; many an unknown student is occupied in retirement in earnest endeavors to throw some new light to help in the unraveling of the skein of mystery. The multitude of papers and contributions on radium and radio-activity which were brought before the last meeting of the British Association for the Advancement of Science afforded a good example of the practical efforts which are being made by students both great and small.

A communication of considerable interest came before the London Physical Society recently regarding the action of radium on the electric spark. The authors, Dr. R. S. Willows and Mr. J. Peck, found that in certain cases the spark from a Wimshurst machine is extinguished by the action of the radiations from radium, and that the current passing is decreased. It seems that the action is altogether different according to the direction of the discharge. When a spark gap longer than 2 centimeters was used and the larger knob of the machine employed was made positive, the radiations were found to have practically no influence. But when the smaller knob was the positive, the radium in most cases extinguished the spark. It is stated that the phenomenon is due to the action of the B rays. Roentgen rays do not produce this effect, even if their ionizing power at the spark-gap is some thousands of times greater than that of the radium; Lenard rays are, however, effective. Prof. F. T. Trouton, who spoke in the discussion at the Physical Society, mentioned the fact that the action of the radium depended upon the direction in which the current was passing, and said that he was quite unable to see an obvious explanation of this phenomenon.

◆

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

A loss of $764 per day in the net earnings of the Cleveland (O.) Electric Railway Company is reported to be the result of recent three and four cent fare experiments.

◆

Among the recent bills introduced in the New Jersey Legislature was one providing for municipal ownership of electric light plants in all cities of the first class.

◆

Arrangements are being made in San Francisco, Cal., for the installation of a plant for communication by wireless telegraphy with Panama by a direct coast route and by way of the East via Denver, Kansas City, Chicago, New York, Key West, Porto Rico and Cuba. Following this, direct communication will, it is said, be perfected between San Francisco, the Philippines, the Orient and the Hawaiian Islands.

◆

Reports from Pittsburg, Pa., Gloucester, Mass., and Barre, Vt., state that electricity is being used successfully in those places for thawing out water pipes.

◆

Experiments were made last week between Paris and London with the Pollak and Virag system of telegraphy. The inventors claim that with their perfected apparatus 40,000 words an hour can be transmitted, requiring the aid of six clerks. As will be remembered in this system the messages arrive written out and not in Morse characters.

◆

Another Atlantic cable is to be laid by the Commercial Cable Company. Bids for the cable and its placing have already been received. The route has been decided, and it is expected that the new cable will be in operation during the coming summer. Clarence H. Mackay said that no new stock would be issued on this cable and that the cost had been met by the Mackay companies to keep the reserve fund of the Commercial Cable Company intact. The new cable will be of high speed and will embody the latest discoveries in electrical work.

◆

The 194th meeting of the American Institute of Electrical Engineers will be held in the Chapter Room, Carnegie Hall, 154 West 57th street, New York City, Friday, February 24, at 8:15 P.M. The following paper will be presented and discussed: "Two-Motor vs. Four-Motor Equipments," by N. McD. Crawford, general manager of the Hartford (Conn.) Street Railroad Company.

◆

The telegraph department of a Western railroad is to give its messenger boys one-half of each day for the study of telegraphy. When proficient they are to be provided with positions, with a considerable increase of salary. Much care is to be taken in the selection of the messenger boys, who will henceforth be considered as apprentice telegraph operators rather than as errand boys.

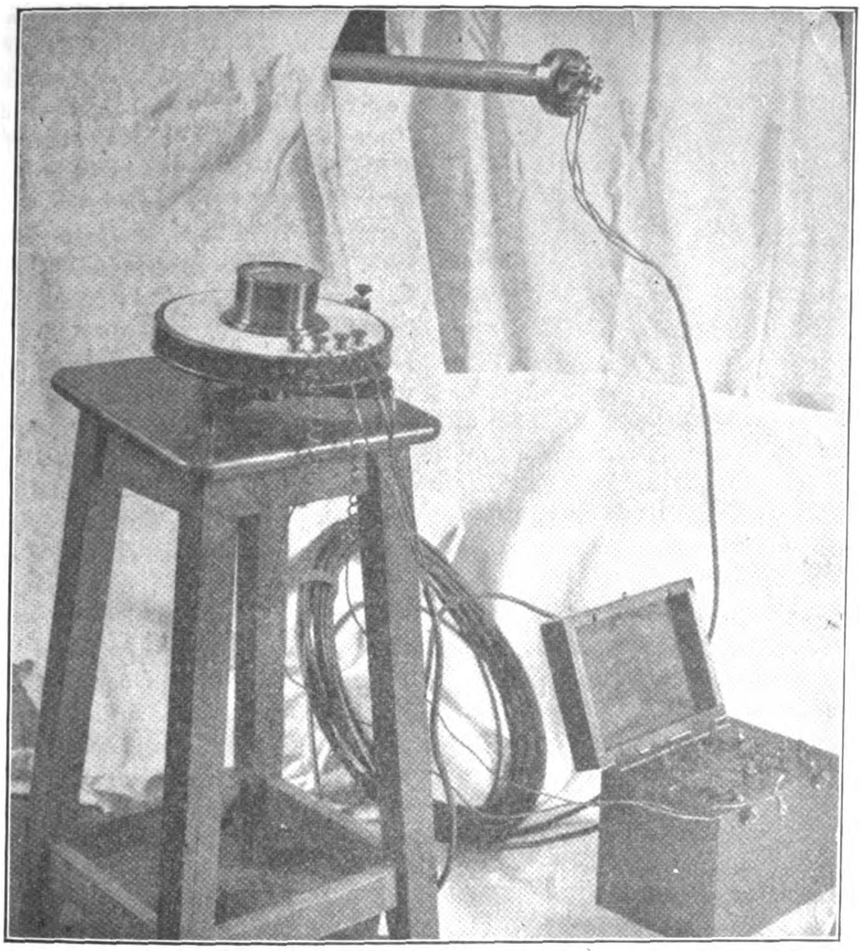
◆

According to the statistical tables relating to German public electricity supply works, compiled annually by the "Elektrotechnische Zeitschrift," the generation of electric current made considerable progress in Germany, says the "Electrician," London, between April, 1903, and April, 1904, the date to which the information in the present tables refers. On April 1, 1904, there were 51 generating stations with a capacity of 2,000 kw. or over. These 51 stations were distributed over 33 towns and their aggregate capacity amounted to 290,700 kw. The largest stations are three of those supplying Berlin: Oberspree, 13,600 kw.; Moabit, 10,640 kw., and Spandauerstrasse, 5,900 kw. Of the 1,028 stations which are enumerated in the tables, 843 supplied continuous current only, and of these 843 stations 803 were equipped with accumulators. It is interesting to note that the capacity of the storage batteries installed amounted on the average to nearly 40 per cent. of that of the generating plant. The 40 continuous current stations without accumulators were mostly small ones. Besides these continuous current stations there were about 80 stations which generated both continuous current and alternating current (mostly three-phase current), and finally there were more than 100 alternating current stations, of which 63 supplied three-phase current only. The sum total of the capacities (including the accumulator capacities) of all the German electricity stations on April 1, 1904, was 531,000 kw.

ELECTRIC PYROMETERS.

BY EMILE GUARINI.

The Siemens electric pyrometer is a platinum wire resistance thermometer, in which the platinum wire is wound upon a refractory cylinder, placed at the extremity of a closed iron tube, and protected by a platinum shield.



Direct Reading Pyrometer.

In this instrument a differential galvanometer and a series of resistance coils are used for measuring the resistance of the platinum coil for the purpose of determining the temperature, which is calculated from reference tables in accordance with the ohmic resistance noted. There are two specific applications of this method, the one stated above and the other in which the temperatures are read off direct by the use of a small d'Arsonval galvanometer in combination with a Wheatstone bridge and a circular dial provided with a sliding contact for manipulating the resistances.

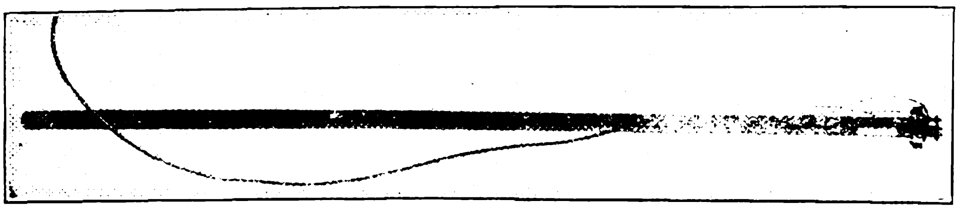
In the first method the galvanometer is set at zero and the extremity of the pyrometer is placed in the furnace whose temperature is to be determined—the upper portion of the tube being protected by fire-clay or an iron shield. The connections are made by means of special cable. When the tube has acquired the furnace temperature an electric button is pressed by which current from a source of electricity flows through two circuits, one of which comprises a coil of the galvanometer and the coil of the pyrometer, and the other part of the divided circuit comprises the other galvanometer coil and the resistance box.

If the resistance of the pyrometer coil does not equal that of the resistance box circuit, the galvanometer needle is deviated, and resistances are then plugged in until the needle has returned to its former zero position, whereby the resistance of the pyrometer coil is determined in ohms. The length of the wires connecting the galvanometer and the pyrometer have no affect upon the results obtained as these wires are of equal resistance, since their resistance varies in accordance with the variations of temperature, and thus mutually counteract each other. It then only remains to consult a table which gives the thermometric degrees for each tenth of an ohm of the observed ohmic resistance of the pyrometer.

It sometimes happens that the pyrometer coil will show an increased resistance after having been subjected to high temperatures for considerable lengths of time, which is probably caused by a slight reduction in the diameter of a wire, probably due to frequent changes in temperature, for which reason this coil should be tested from time to time at fourteen degrees Centigrade. Should the normal resistance of ten ohms have been increased for example by R ohms, all results obtained at higher temperatures should be multiplied by $\frac{10}{R}$ and the temperature determined by reference to the table in accordance with the resistance thus found. This correction is based on the observed fact that the amount of increase of the resistance in the coil, in relation to the temperature, does not change when the diameter of the wire is reduced.

The direct reading pyrometer comprises a Wheatstone bridge in which one branch has an adjustable resistance made up of a solenoid attached around the outer edge of a circular dial, which is divided into thermometric degrees, and which has at the center a small d'Arsonval galvanometer that is not affected by exterior magnetic fields; an indicating sliding contact is used for adjusting the resistance of the variable branch circuit of the bridge, and for indicating the temperature of the coil on the disk when an equilibrium has been obtained. The contact pieces are so combined and adjusted to the stem of the sliding contact, that it only suffices to press a button to place the battery in circuit with the galvanometer and the pyrometer. The whole apparatus is mounted on a tripod.

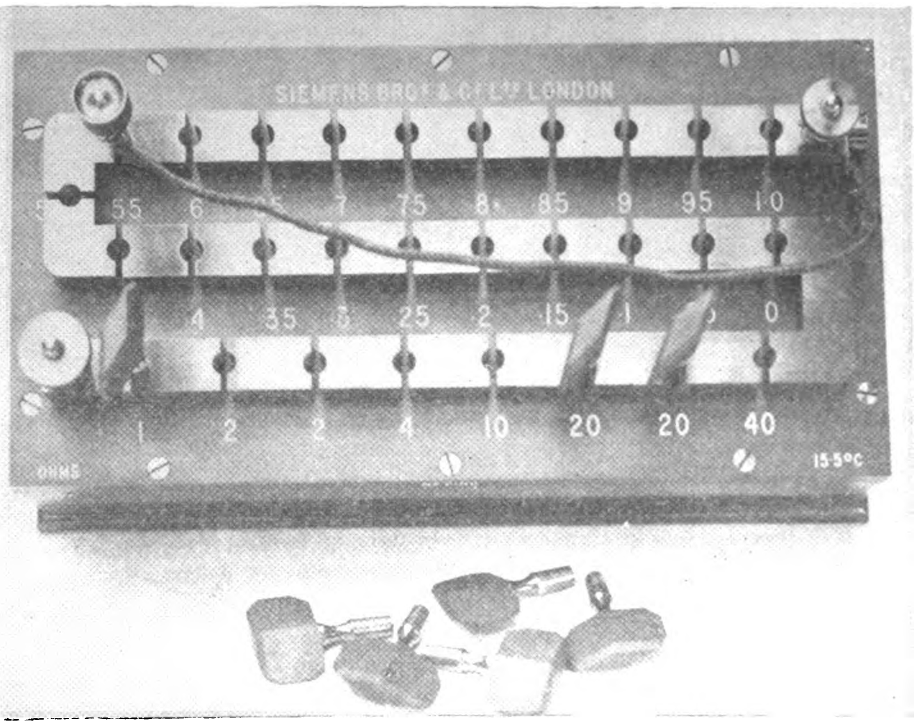
The pyrometer is connected to the apparatus by a three wire cable attached to the terminals, X X_1 and Z, the current source being connected to the terminals, C Z. In taking measurements, the sliding contact is moved around the graduated disk, and the contact lever is frequently pressed, and these operations are continued until a point is reached in which no deviation of the galvanometer needle is noted on pressing the key. The index



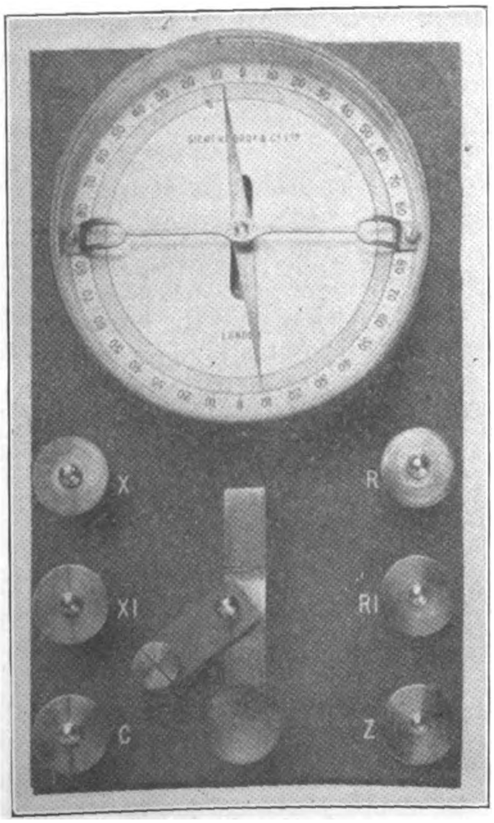
Ordinary Form of Electric Pyrometer.

under the sliding contact indicator will then give a direct reading of the temperature of the pyrometer coil.

This last form, although quite recently developed, is fully as sensitive as the first one mentioned, but it is preferable in that it obviates the inconveniences and the risks of errors due to the use of conversion tables; furthermore, there is only one part of the apparatus to be adjusted, and in contradistinction from the first method, exterior magnetic influences, due to the proximity of dynamos or strong electric currents are not to be feared.



Resistance Coils for the Electric Pyrometer.



Differential Galvanometer With Resistances for use with Pyrometer.

Whatever form of apparatus is selected, the pyrometer is found to be very precise, the measurements agreeing closely to 1 per cent. when compared with those of an air thermometer. It is quite as simple in practical use as its operation indicates, as it may be placed in the hands of an average intelligent workman.

It will be found adapted to the requirements of works where it is necessary from time to time to control the temperatures of furnaces, retorts, etc., especially where the processes of manufacture require the maintenance of a definite temperature during certain operations. Thus the apparatus will unquestionably be of great service, and it has already been adopted by the principal steel works of Europe, and by Government inspectors for determining the temperature of furnaces, during the manufacture of heavy steel pieces and armored plate.

THE LAST NEW GLOW LAMP.*

It is credited to electric lighting, even by its worst enemies, that it has made the gas people wake up. The gas lamp has been much improved and as the process has gone on there has been evidence of a reaction on the newer light. It will be remembered that in the beginning of electric lighting all the efforts of electric inventors were concentrated on the problem of producing a decent lamp. Then came a time when the carbon glow lamp was accepted as practically perfection, and the efforts of engineers were devoted to the cheapening of the production and distribution of electrical energy. Once again the pendulum has swung back, and the market is full of new lamps, and the tale of new lamps. The last example comes from Germany and threatens to be a formidable competitor of those established or seeking establishment. The Siemens & Halske Company has been for a long time engaged in an endeavor to improve the electric light at a place where there is the greatest room for improvement, viz., the hopelessly inefficient glow lamp; but the matter has been kept very quiet; indeed, the first publication was made at a meeting of the Berlin Elektrotechnischer Verein, on the 17th ult, when two papers were read by Mr. O. Feuerlein and Dr. von Bolton. The papers, and the communication of Mr. W. von Siemens, are reprinted in the "Elektrotechnische Zeitschrift" of January 26, with illustrations of the lamp and filament. There is, therefore, no longer any secrecy about the matter, and indeed one may expect to find the lamps upon the market almost immediately.

The new lamp has a metallic filament, and in fact appears to constitute a solution of a problem to which Mr. Edison originally set himself without result. Undeterred by his failures the Siemens & Halske Company some very considerable time ago set Dr. von Bolton to work on the task of finding a substance capable of being drawn into a filament, and having a melting point so high that it would give a white light before failing. What Dr. von Bolton has done is to ransack the unused elements, and it seems that he has found what is wanted in tantalum. All that is known by most people of the properties of the so-called rare elements is the descriptions of them at the end of the chemistry books. These are mostly wrong for the simple reason that the things have been prepared once or twice by men who were not metallurgists, under circumstances of considerable difficulty, and without hope of any commercial gain which would justify the expenditure of time and money in purification. Of the two standard ways of getting anything which resists ordinary methods of reduction, the electric furnace invariably involves pollution with carbon. Electrolysis of the fused salt belongs rather to an element of a low melting point, and everyone knows the difficulty of getting a pure deposit. In fact, to draw any conclusions from the descriptions of the unused metals that appear in the books is very much the same as if one were to argue on the electrical possibilities of Fe from a small specimen of cast-iron. Dr. von Bolton, in the course of his researches, tried vanadium, and found its melting point (as indeed he should have had fair warning) was much too low. The obvious course was then followed of trying the remaining elements of the same class—first niobium and then tantalum. The tantalum he has obtained is an entirely different substance to the tantalum of the books.

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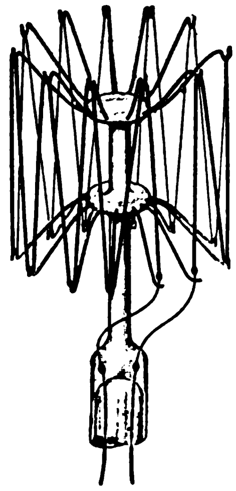
*From the "Electrical Times," London.

Pure metallic tantalum resists acids like platinum. It will burn in air, so that the lamp must be run in a vacuum; it absorbs hydrogen, nitrogen and carbon. Consequently, the tantalums that we have been put off with hitherto, though metallic in appearance, were really compounds or alloys. The tensile strength of pure tantalum is 25 per cent. better than steel. It can be drawn into wire, and it has the property which is so valuable in soft iron, viz., that it becomes malleable long before it actually melts.



Shape of Tantalum Filament.

Its electrical properties are even more convenient; the resistance of a meter wire of one square millimeter cross section is .16 ohms., but when run at its working temperature the resistance rises to .83 ohms (say five times as much). Metallic tantalum has, in fact, as becomes a metal, a strong positive temperature coefficient. The ordinary carbon filament is, as is well known, deficient in this respect, though not (when at the temperature of incandescence) to such an extent as to make special treatment necessary, but the negative coefficients of the Nernst and of the arc constitute an effective nuisance.

The chemical difficulties of the manufacture of tantalum, which are not very serious, being removed, the mechanical problem remained of constructing a glow lamp that should have a filament two or three feet long, so as to run at a reasonable voltage, and this part of the work was set out by Mr. Feuerlein. How the difficulty has been overcome will be seen from the illustration of the filament given herewith. The wire is looped round and round on a kind of frame. All metallic filaments are necessarily low resistance filaments, but it will be seen that, after all, there are compensations in working in metal instead of in carbon, or in a brittle paste of oxide. The type of lamp is already standardized for 110 volts 24 candles, and this lamp has a consumption of 1.6 watts per cp. The filament is 25 inches long and has a diameter of .05 millimeter. As the weight of it is 22 milligrams, a pound of tantalum will make more than 20,000 lamps. The life of the lamp is about 500 hours, and its behavior as regards over-running or under-running is very similar to that of the carbon lamp, except that it supports excess of pressure very much better. Started at 1.6 watts there is a fall off after 500 hours, till at 1,000 hours it becomes a 2½ watt lamp. It is, therefore, quite possible that it may end as the 1,000 hour lamp that we are used to. It will be seen that the consumption renders the lamp an immediate competitor of the Nernst and the small inclosed arc. Its great point is that, like the osmium lamp of Dr. Auer von Welsbach, it contains no mechanism. The physical as apart from the economic end of the lamp's life appears to come when the wire becomes mis-shapen and brittle. Repeated expansion and contraction results in a shortening of the length of the filament and a roughening. The new filament is quite tough, but old lamps should not be taken out or shaken (as with the gas mantle). Curiously enough, a broken lamp can frequently be mended by a simple process of tapping it until the loose ends touch each other, when they weld themselves together. It then, of course, goes on as an over-run lamp. A similar habit was promised for the Nernst burner, but nothing came of it, and it seems unlikely that this auto-repairing faculty will ever come into practical use. The appearance of the filament has already been illustrated; it merely remains to add that it is inclosed in a vacuum bulb in every respect similar to that of the glow lamp of commerce. The limits of the voltage and size mentioned do not seem in any degree fixed. It is possible that they may be capable of considerable extension, but at present only 100 to 120 volt 24 cp. lamps can be procured.

After the reading of the papers at Berlin some additional information was given by Mr. Wilhelm von Siemens; but, except for the opening remarks of the chairman, Dr. Micke, there seems to have been no discussion. Beyond appreciation of the labors of Dr. von Bolton and Mr. Feuerlein, the important part of Mr. Siemens' speech was a declaration that the lamp was quite ready. The development has been done without any preliminary writing in the newspapers, and not a word has been said about it until the company has not only got a lamp that will go, but is ready to go on turning them out for the market at the rate of 1,000 per day. Specimens of the present pattern have been running for a year.

There remains one point upon which the tantalum lamp is somewhat tantalizing; there is no information in the paper upon price. As regards the osmium lamp, with which one naturally compares it, when its producers have been asked whence they are going to get their osmium, they have replied in terms which, translated out of the language of politeness, amount to 'That's our business; we have got it.' At the same time, one naturally wants to know in what quantity. There is this about tantalum, that, although supposed to be a rare element, it exists in a quite sufficient quantity, even if no fresh discoveries are made, to provide the material of glow lamp filaments. That difficulty is no more likely to arise than in the case of finding sufficiency of the elements of the cerium group to make Welsbach mantles. And when manufactured in quantity there seems nothing in the process of production which should make it a matter of physical necessity that the new lamp should be excessively dear. It appears that the metal is reduced from the double fluoride of potassium and tantalum substantially after the manner to be found in the books. The impossible looking powder thus obtained when heated electrically under the air pump parts with the gases it has absorbed during the process of manufacture, and fuses into a workable metal.

REFUSE AS FUEL.

In view of the interest now being taken in both England and the United States in refuse destructors, the abstract of a report of a two days' test made in that country and recently published in the London "Electrical Review" should prove instructive.

The destructor is of the Meldrum "Simplex" type. It is provided with four furnaces, that is, there is one continuous grate, 20 feet by 15 feet, with four doors for feeding and clinkering, and four separated and closed ashpits, which are supplied with hot air under pressure. The ashpits are also fitted with steam jets by means of which the forced draught is obtained. The fires above the ashpits are independently controlled by the regulation of the air and steam jet supply. According to the report referred to, the liberated hydrogen due to the passing of steam through the incandescent fuel recombined with oxygen immediately above the bed of fuel, little or no air being admitted above the fires for secondary combustion. The refuse, therefore, is exposed to the maximum temperature attainable in the furnaces, instead of being first partly volatilized and then consumed as gas. Any gas which may be given off during the charging of the furnaces is consumed in the brick combustion chamber which is interposed between the grates and the main flues. The estimated mean temperatures on the two days were 2,364 degs. F. and 3,236 degs. F. A costly electric platinum wire resistance pyrometer was destroyed on being lowered into the end of the combustion chamber where the hot gases enter the boiler. A special arrangement is made at one end of the grates for the combustion of slaughter house offal. This is poured in, in a semi-liquid state, through a funnel, and any of the gases given off from it have to pass over the whole length of the fires of the four furnaces. During the test, however, no refuse of this nature was burnt, but only ordinary ashpit refuse.

Owing to the destruction of the platinum pyrometer and the bursting of a mercury nitrogen pyrometer used in the end flues, and owing also to the unreliability of high temperature thermometers, either of the mercurial or electric type, due to a considerable shifting of the zero point, the most reliable temperature data is that of the thermometers placed in the main flues leading to the chimney.

The refuse was carefully weighed on entering the premises; the ashes drawn from the furnaces were also weighed and analyzed; the feed water was measured by means of three tanks; and continuous gas samples were collected and analyzed at once in an Orsat apparatus. Similar samples were passed through calcium chloride and potash tubes to determine both the amount of moisture and the carbonic acid. These are important details in refuse destructor tests.

The boiler used in conjunction with the destructor is of the Lancashire type, 30 feet x 8 feet, constructed for a working pressure of 150 lb. per sq. in.

From Table I we note that on the two days of the trial the mean boiler pressure was 135.1 and 134.2 lb. per sq. in., the temperature of the feed-water 37.3 degs. and 35.3 degs. F., and the evaporation per lb. of fuel from and at 212 degs. F., including that used for the steam jets, was 1.698 and 1.877. The actual evaporation was 1.419 and 1.555 lb. per lb. The temperature of the chimney gases averaged 645 degs. F., which would allow of the addition of an economizer, by means of which, so says the report, the evaporation from and at 212 degs. F. would be brought up to fully 2 lb. per lb. of refuse.

Table II contains details of the gas analyses, which were only obtainable by making continuous tests, and with the help of the information thus obtained, it was possible to calculate the chemical composition of the fuel. The average of the second day's test is given as follows:

Nitrogen	79.888
Oxygen	5.836
Carbonic acid	14.233
Carbon monoxide	0.043

The estimated amount of carbon in the ashes on the second day was 17.69, and the mean ratio of moisture to CO_2 in the waste gases 0.5479.

The composition of the fuel as calculated from the above data is:

	First day.	Second day.
Carbon (burnt) per cent	21.33	31.58
Carbon (in ashes) per cent	4.17	5.70
Total carbon in fuel, per cent	25.50	37.28
Moisture, per cent	35.00	30.53
Mineral matter, per cent	39.18	31.50
Total refuse, per cent	100.00	100.00
Steam used in jets, per cent	16.22	18.7

The estimated calorific value of the fuel is as follows:

	First day.	Second day.
Calorific value of total fuel B. T. U.	3,473	5,411
Calorific value of total fuel evap. units	3.595	5.601
Calorific, less unburnt carbon, B. T. U.	2,867	4,583

A balance sheet of the heat expenditure has been made out from the data in the tables, which shows that the heat utilized in the production of steam, exclusive of the blowers, amounted to 36 per cent., which is considered a high duty in view of the fact that the carbon and heat in the ashes accounted for a loss of 20 per cent. The heat carried up the chimney amounts on the average to 19.3 per cent., which would have been lower if the refuse had contained less moisture.

In addition to the report the makers sent diagrams of the temperatures in the down-take recorded by a Callender's electric recording pyrometer, from which we note that the lowest temperature recorded is 350 degs. F., which occurred during the cleaning out of the combustion chamber. During ordinary working, the lowest temperatures are, of course, obtained during clinkering, and this appears to average out to about 800 degs. F., the highest temperature shown on the chart being 1,350 degs. F.

We might call attention to the fact that the above tests were of approximately 8 and 9 hours' duration respectively, and we gather that no economizer was used. It would be interesting to compare the evaporation obtained during longer periods. Quoting from a table previously published, we find that during 473½ hours' working continuously, except week ends, the average evaporation was 1.85 lbs. per lb., and we understand that an economizer was then used. Quoting from the same table we see that in an 8 hours' test the average evaporation, with an economizer, was 1.96 lbs. per lb., which is very close to the 2 lbs. referred to in the report as being possible.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

ELECTRIC LIGHTING.

Advantages of the Three-Wire System.—The three-wire system has its advantages, which are found in the saving of copper and the increased flexibility of the system through the use of a higher pressure for motors. Between the middle or neutral wire and the outer leg on either side may be found a pressure of about 115 volts. Between the two outer wires double this pressure or 230 volts is on tap for motor service. Take the case of 50 lamps taking ½ ampere apiece, fed respectively by a two and a three-wire system for purposes of comparison. On this basis 50 lamps require 25 amperes, and a two-wire system would have to supply a wire of sufficient cross-section in circular mils, to carry this current with the small loss in pressure expected in this instance. The formula for this size of wire is given as follows:

$$\text{Circular mils} = \frac{\text{number of feet of wire} \times \text{amperes} \times 12}{\text{volts drop}}$$

In the above case the circuit is 100 feet in length and a drop of 2 volts is allowed in the wire, then the calculation will give

$$\text{Cir. mils} = \frac{200 \text{ feet} \times 25 \times 12}{2} = 30{,}000.$$

The 100-foot run would mean 200 feet of wire and the 30,000 circular mils represent the square of the diameter of the wire in mils or thousandths of an inch. For instance, a wire of 100 mils diameter is 100 one-thousandths of an inch in diameter or one tenth of an inch. This wire will have 100 × 100 or 10,000 circular mils cross-section; but the wire tables give both the diameter of a wire in mils and its cross-section in circular mils with the size corresponding. The wire table most in vogue is the Brown & Sharp or B. & S. gauge.

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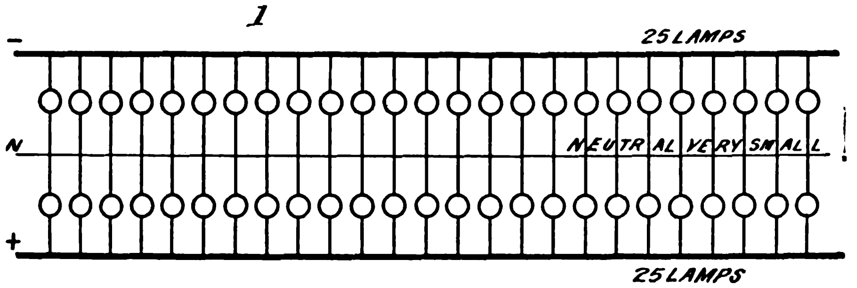

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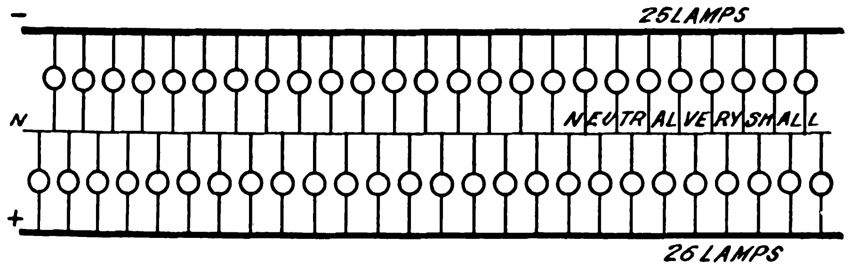

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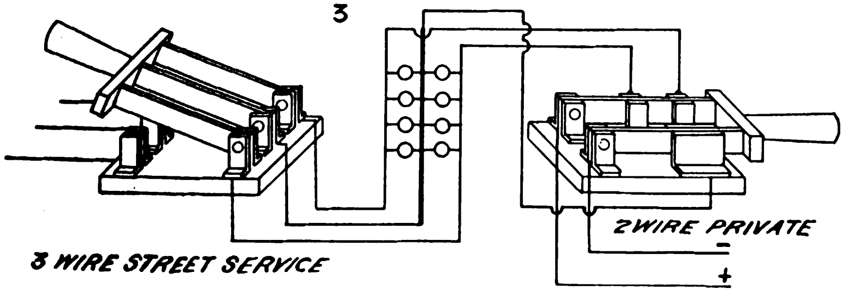
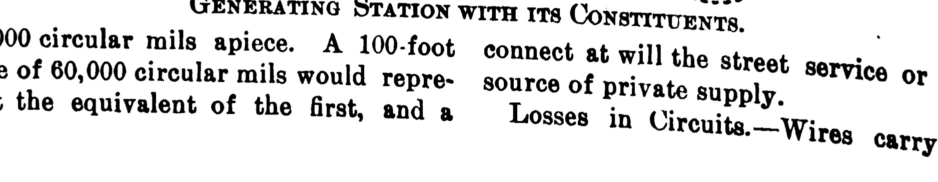


1—Balanced system. 2—Unbalanced system, neutral wire carries current of one lamp. 3—Combination two and three-wire system.

If the two-wire system calls for a wire of 30,000 circular mils for 50 lamps taking ½ ampere apiece with a 100 foot run and a 2 volt drop, calculation will show a smaller wire for a three-wire system of lighting with just as many lamps. In a three-wire system the lighting must be *balanced*, that is to say, as many lamps must be placed on one side of the neutral wire as the other. This will mean 25 lamps on each side of the neutral wire, which will represent 25 groups of two lamps apiece. The two lamp groups are connected across from the + to the neutral wire and from the neutral wire to the − wire. But examination will show that the 230 volts will send ½ ampere through every two lamps in series. The neutral wire in this case, when the circuit is perfectly balanced, performs no service. If there were 25 lamps on one side of the neutral wire and 26 on the other, then it would carry the current of one lamp, namely, ½ ampere. A neutral wire, in a three-wire system, therefore, carries only *the difference* in current between one side of the neutral wire and the other. Consequently, if the circuit is balanced it carries no current at all. This is the case with 50 lamps burning on the three-wire system. Only 12½ amperes are required at 230 volts pressure, which, with the same length of run, 100 feet, and the same drop, 2 volts, according to the formula calls for the following number of circular mils: $200 \times 12.5 \times 12 \div 2 = 15{,}000$. In interior house wiring, for *only* the three-wire system, three wires of this size would be used. This means in comparison, that the two-wire system would require two 100-foot wires of 30,000 circular mils apiece, and the three-wire system three 100-foot wires of 15,000 circular mils apiece. A 100-foot wire of 60,000 circular mils would represent the equivalent of the first, and a 100-foot wire of 45,000 circular mils the equivalent of the second case.


AIR COOLED STEP UP STATIC TRANSFORMER
ROTARY CONVERTER PRODUCING A.C.
D.C. GENERATOR
HIGH TENSION A.C. CONDUCTOR
ENGINE

GENERATING STATION WITH ITS CONSTITUENTS.

The saving would be the difference between 60,000 and 45,000 or 15,000 circular mils, which is 25 per cent. If the neutral wire, as is the case in the system employed in the conduits laid in the city's streets, is not as large as the outer legs, and it is easy to see that it need not be, the saving in copper is much greater. Because here, the neutral wire carrying only the difference in balance between one side of the circuit and the other, can be comparatively very small if the lighting company enforces its demand, before supplying current, for balanced circuits. The wiring contractor must see that such a balance exists in planning out the circuits, otherwise the use of the current is refused. In spite of every precaution, a certain small difference in balance in the aggregate must be taken up by the neutral wire through consumers turning lights on and off, which makes a perfect balance all of the time an impossibility, in spite of the wiring and the actual balance of the lighting circuits.

Combination Two and Three-Wire Circuits.—In private houses and public buildings where electric light plants are installed it may become necessary through a break-down of the plant to throw in the street service. A difficulty here presents itself unless the wiring conforms to the system in the street. If it is a simple alternating current system it may be thrown on with impunity provided it is of the same pressure as the lamps require. If it is a direct current three-wire system, the Edison system in fact, the wiring of the building must be composite, that is, suited to both a two-wire and three-wire system of lighting. All of this is easily accomplished if the building has been wired according to the three-wire system, only the neutral wire must be of *twice* the cross-section of the two outer legs. It can then be used for either purpose without any change whatsoever. A large double throw switch is necessary to connect at will the street service or the source of private supply.

Losses in Circuits.—Wires carrying

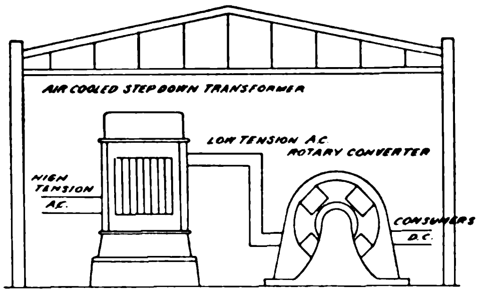
electricity from point to point dissipate energy to an extent dependent upon the current they carry and their resistance. This waste of power appears in the form of heat. An incandescent lamp is a good illustration of this when in use. The resistance of its carbon filament is sufficiently great with the current passing through to raise it to incandescence. In the same manner although not to the same extent a conductor is heated by the energy it contains and a certain percentage of power disappears. This can be regarded in two ways: first, as caused by lost volts or drop, and second, as due to the energy wasted as heat. To calculate the first or volts lost this formula is employed:

Volts lost = amperes in wire × resistance of wire.

If the lost volts are multiplied by the amperes, the watts wasted in the wire are obtained. On the other hand, the power which generates heat can be calculated by the formula: Watts wasted in heat = amperes × amperes × resistance of wire. These two results will be the same, as shown by the following example: Take a wire of 10 ohms resistance carrying 2 amperes, the volts lost $= 2 \times 10 = 20$ and the watts wasted $= 2 \times 20 = 40$. If the watts wasted in heat are calculated by the other method the result is: Watts wasted $= 2 \times 2 \times 10 = 40$, or the same figures in both cases. One is obtained by the product of the drop in volts by the amperes, the other by the square of the amperes by the resistance. As there are 746 watts to a horse power, the percentage of a horse power wasted in the conductor can be readily obtained.

Where many lines are in use carrying power the loss is considerable, particularly when the current is heavy. The loss increases rapidly as the current increases and as it decreases diminishes. In the case just stated, if the amperes are raised from 2 to 4 the watts wasted increase from $2 \times 2 \times 10$ to $4 \times 4 \times 10$, which equal respectively 40 and 160 watts, a difference of 4 to 1 with only twice the current. Therefore if the resistance of a line remains the same and the current is doubled, tripled or quadrupled the waste of power is increased 4, 9 and 16 times respectively. Reducing the current in conductors transmitting electricity for light and power and increasing the pressure is a logical process. To accomplish this successfully in electric light practice has been one of the most difficult problems. It has been solved of a flexible system of transformation by means of which a direct current is changed into an alternating current of high potential, and a high potential alternating current into a direct current of low potential.

Method of Transformation.—A central station in the heart of a great city represents two ideas in electric lighting. It may generate electricity for both *transmission* and *distribution*. In other words, it is equipped with apparatus by means of which it can distribute electricity at low potential within a considerable radius of itself. It can also transmit energy at a high pressure to certain points relatively far removed, and there have that energy undergo a process of transformation to low pressure preparatory to its distribution. Essentially, the function of a central station is the generation and distribution of electricity for electric light and power service, but it must operate as well as a power transmission plant in order to distribute its energy with economy over an increasing radius. To deliver heavy amounts of energy one or more miles away with little loss and thus create a new center of distribution is accomplished as follows:



SUB-STATION WITH ITS CONSTITUENTS.

The central station is supplied with two classes of machinery; one, which generates the current at low pressure, continuous and ready for distribution; the other which transforms it to a high pressure alternating current for transmission, prior to ultimate distribution at a distance. The low pressure direct current generators supply an area in the immediate neighborhood by means of the three-wire system. They also supply energy to rotary transformers or converters, which are machines representing a combination of a motor and dynamo in one. On one side the machine receives a low pressure direct current which operates it as a motor; it gives out an alternating two or three-phase current at a somewhat higher pressure. This is obtained by means of two armature windings, one of which is for continuous and the other for alternating current. A commutator is connected on one side of the machine to the direct current winding and collector rings on the other side to the alternating current winding. Although a direct current will rotate the armature and thus generate on the other side of the machine a two or three-phase alternating current, if a two or three-phase alternating current, as the machine may require, is sent in at the collector rings the resulting rotation will develop a direct current at the commutator. Thus a rotary converter is capable of taking in a direct current and giving out an alternating current, and, conversely, it can take in an alternating current and give out a direct current. It is thus, as a rotary converter, truly convertible, and for this reason invaluable in the transmission of power.

The alternating current given out by the rotary converter is practically the full equivalent of the energy sent in in the shape of a direct current. This alternating current is received by a transformer in which, though entering at a few hundred volts it leaves at a pressure of many thousands, but otherwise still unchanged in character. In this manner, a current of high pressure and alternating is sent over transmission lines either underground in conduits or overhead to reinforce distant stations or to create at new points what are called sub-stations.

The Sub-station.—The current, which can be considered, for purposes of illustration, a 5,000-volt three-phase, is now received at the sub-station to undergo a new process of transformation. To outline the previous process in the station itself, it is only necessary to consider a 115 or a 230-volt direct current entering the rotary converter and issuing as a 300 or 500-volt three-phase alternating current. Sending this current into a transformer at this pressure, from which it emerges at 5,000 volts and goes over the line, brings these operations to a point where the substation becomes of interest. In this edifice are to be found stationary or static transformers and rotary converters. The power is received in the transformers at 5,000 volts and issues at 300 or 500 volts. It is then directed into the rotary transformer from which it issues as a continuous current of 115 volts and feeds into the three-wire system in common with the generators of the central station.

Why a Two or Three-phase Current is Necessary.—A two or three-phase alternating current is particularly adapted to power plants because of this qualification—it can be used in motors which thereby become *self starting*. A single-phase alternating current has been applied to some extent to the same purpose by means of special appliances, and the ordinary series motor will operate with a single-phase current, but the type of motor now in use extensively for power plants and power transmission is of the character known as "the rotary field motor." In other words, a two or three-phase alternating current can be sent into a motor so designed that it creates within it the equivalent of a rotary field. A wave of magnetism sweeps around and carries with it the armature which it affects by induction. This armature is of simple construction; an iron core, laminated, conductors closed upon themselves and a multipolar field. The current enters the field and produces the rotating wave of magnetization, the armature follows a little behind in speed. No commutator is needed and therefore a great advantage is at once gained. The rotary field motor is the result of the work of Tesla, Ferraris and Dobrowolsky and was the only means of making power transmission and distribution a success. If appropriate conductors are placed on the armature of a two or three-phase motor and connected to a commutator with brushes, etc., any transformation required can be obtained within the limits of insulation. Street railway as well as electric light and power plants can thus be operated by power obtained from a distant source. This power, sent at a high pressure alternating, can be received at various sub-stations along the line of the trolley or third-rail system. It is transformed by means of *step-down* transformers and sent into rotaries, from which it issues as a direct current at the standard pressure. The transformers which raise the pressure are called *step-up* transformers and those which lower it *step-down*. Thus the conjunction of rotaries and static transformers provide an ideally flexible and highly economical system for electric transmission and distribution.

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THE AMERICAN DIESEL ENGINE.*

BY NORMAN M'CARTY.

Many of your members will remember certain papers published some years ago in regard to the merits of a new invention in prime movers called the Diesel motor.

The claims set forth as to the economy of this device were so large and far-reaching that most practical men received them with a shrug of the shoulders. They were, nevertheless, not only true, but somewhat understated. From the small Diesel motor of 20 hp., which gave these remarkable results, has grown, by a natural process of evolution, the American Diesel engine of to-day, at present built in sizes from 75 B.H.P. to 1,000 B.H.P.

A short explanation of the working of this engine may be permissible as many, no doubt, have forgotten the former explanation, while to others the matter may be entirely new.

The Diesel engine is essentially an oil engine and not a gas engine. Gas engines and previous oil engines which acted on the gas engine principle have all in common the explosion of a charge. This charge is a mixture of a given quantity of gas or of a given quantity of oil vaporized so as to act as a gas during the process, combined with a quantity of air varying from seven to eleven times the volume of the gas or vapor. It was well known that some previous compression would add to the economic results of the explosive action. But in all cases the power was obtained by an explosion, which, from the moment of ignition, was beyond control of the operator, or of the governing mechanism of the engine. This fact limited the efficiency of all governing devices which could be applied, and troubles with the ignitor caused other irregularities, so that even where local conditions made the gas engine (or vaporized oil engine) the worthy competitor of the steam engine, uncertainties of its operation threw doubt on the wisdom of the substitution.

Furthermore, a cheap gas, necessitating the installation of a large and cumbersome producer plant, was the only escape from such costly fuels as gasoline or kerosene.

The Diesel engine made the use of the cheapest liquid fuel, such as crude oil, fuel oil and distillates, possible. To these recent experimental developments promise to add the waste product from gas works known as light water gas tar.

The Diesel engine works on an entirely new principle. First of all it dispenses with the so-called charge or mixture, which in all explosive engines must vary only between the limits of one gas to seven air, and one gas to eleven air. Its cycle is the same as the gas engine, the well-known Otto cycle. There its similarity with the gas engine ends absolutely; in everything else it follows the precedent of the steam engine.

Its first stroke is a suction stroke, drawing in a cylinder full of pure, clean air; on the second stroke it compresses this to a tension and consequent temperature sufficient to ignite any fuel which may be injected into it; at the beginning of the third stroke a small quantity of fuel oil is injected into this red-hot air as a spray by a jet of highly compressed air, and thus, in a completely atomized state, the fuel meets and mixes with the hot compressed air in the cylinder, burning completely, and during a period of time exactly regulated by the governing mechanism of the engine, generally through one-tenth part of the stroke (when engine is operating at its rated capacity), subsequent to which the stroke is finished by the expansion of the burnt products or gases; the fourth stroke discharges these products of combustion and leaves the cylinder empty and ready for another suction stroke.

It is evident that the work expended in compressing the cylinder volume of pure air is given off again to the shaft of the engine during the combustion or motor stroke, so that the loss is simply the fractional loss during the compression stroke.

This simple process, absolutely new and original with Diesel, has enabled him to accomplish with one-half pint of common crude or fuel oil as much as the explosive engine does with a full pint of the much more expensive gasoline.

A recent comparison of results extending over a period of regular daily service of six months has shown the consequent economy of a Diesel engine over a first-class gasoline engine, which it displaced, of 600 per cent.

The modest statement set forth some years ago by the promoters of the Diesel engine, and covered by absolute and binding guarantees, are that 100 B.H.P. hours measured in the crank shaft of the engine will require not exceeding eight gallons of crude oil or fuel oil when the engine is running at or near its greatest capacity, nor more than nine and one-half gallons when it is running at or near half load.

The regulation in the Diesel engine is not dependent on hit or miss, but can be followed up or down the scale as closely as in a steam engine. In the latter it is a question of cutting off more or less from a pretty large volume of steam at each stroke; in the Diesel engine it is the finer one of cutting off a more or less minute quantity of oil from the small volume delivered by the fuel pump at each stroke. It is accomplished by direct action of the governor on the suction valve of the fuel pump, which is held open during a greater or less portion of the pressure stroke, and thus the pump delivers the exact quantity of oil required during each motor stroke of the engine. While the mechanism is necessarily smaller and more delicate than in the steam engine, it also requires less power and its effect is more immediate.

In a compound steam engine the volume of steam left in the high pressure cylinder at the point of cut-off must be used in the next stroke of the low pressure cylinder, whether at the time more or less would be the proper quantity for that stroke. In the Diesel engine the regulation acts on each cylinder just at the time and in the exact quantity then required.

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* Paper read at the 13th annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 18-20, 1905.

There remains only the drawback common to all four-cycle engines, that there is but one motor stroke for each two revolutions. For electric light work, triple cylinder engines and heavier fly-wheels successfully overcome this, while for electric railway work resort is had to still larger fly-wheels and four or six cylinders by coupling on engines at each end of the same dynamo shaft.

As for the accessibility, reliability and durability of the engine, three years of experimental work have placed these fully on a par with the best steam engine practice, and since then, two years, and in some cases nearly three years, of continuous service by a number of Diesel engines of the new American type gives sufficient examples of the success in this work.

An installation of 50 engines, aggregating 6,000 B.H.P., and representing 25 separate and distinct plants, in service from 6 months to 5 years, has so demonstrated the fuel economy that the American Diesel Engine Company offer the following formula to any user of power, by which he may determine for himself the exact cost of fuel from his operating conditions, under the supervision of his own attendants and for any length of time he may desire, the result of which they are ready to guarantee, assuming that the plant has averaged one-half load for the time under consideration:

FOR ELECTRICAL TRANSMISSION.

$$\frac{A \times 365 \times B}{8} = \text{cost of fuel per year.}$$

FOR MECHANICAL TRANSMISSION.

$$\frac{A \times 365 \times B}{10.75} = \text{cost of fuel per year.}$$

In which case

A = number of kw. hours, or B.H.P. hours per day.

B = cost of oil fuel in cents per gallon.

For example, assuming that an electrical installation delivers 1,000 kw. hours per day, with oil fuel at 3 cents per gallon, we have

$$\frac{1{,}000 \times 365 \times \$.03}{8} = \$1{,}368.75 \text{ as total}$$

cost of fuel per year of 365 days. But as the Diesel plant requires no boilers and eliminates the extra expenses of the fire room it should be credited with this necessary charge against a steam plant, so that assuming the charge for water, labor and depreciation of boilers for a steam plant of this size at $2.50 per day, or $912.50 per year, the cost of fuel for the Diesel would be only $1,368.75 — $912.50, or $456.25 per year in excess of fire-room charges (exclusive of coal used) necessary for steam, and the total coal bills for a steam plant must be kept within this amount if it would meet the operating expenses of a Diesel plant. But an average steam plant delivering 365,000 kw. hours per year would probably require under actual operating conditions 1,100 tons of coal at, say $3 per ton, or $3,300, and assuming the labor and supplies in the engine room of each plant as equal, the Diesel would make a saving of $2,843.75 per year, or at least 30 per cent. of the cost of installation.

A larger plant, delivering 10,000 kw. hours per day, would cost for the Diesel $13,687.50 per year, with fuel at 3 cents per gallon.

Assuming this to be a 1,000 kw. installation, the charges in the fire-room of a steam plant (which charges we assume to cover depreciation as well as water and labor) would approximate $5,000 per year, leaving the cost for Diesel fuel at $8,687.50 in excess of fire-room charges for a similar size steam plant, and which must cover coal bills, as suggested above, to meet the Diesel economy.

Three million, six hundred and fifty thousand kw. hours for a steam plant would represent at least 7,300 tons of coal, or, at $3 per ton, $21,900, a saving for the Diesel of $13,212.50, equal to 60 per cent. of the coal bill, or approximately 20 per cent. of the cost of installation. The coal consumption being based on 4 pounds per kw. hour, or 2½ pounds per I.H.P., will probably not be seriously disputed by any steam authority, considered as covering average working conditions.

The essential features that distinguish the Diesel engine from all other prime movers are:

1. As all oil fuels have practically the same calorific value, the cheapest is equal to the highest priced for the purpose intended.

2. The fuel consumption being controlled automatically by the governor, the consumption on variable load approaches very much nearer the theoretical requirements than when dependent on manual control, as in a steam plant.

3. The medium for compression being pure air and non-explosive, no back-firing is possible.

4. The ignition being caused by the heat of compressed air, no ignitors are necessary, and no mixtures or explosions tolerated.

5. The ignition and combustion is gradual and continuous, with a surplus amount of air to maintain complete combustion. Consequently, no carbon is deposited and no fouling of valves or cylinders possible.

ENGLISH ELECTRICAL NOTES.

(From our London Correspondent.)

ARMATURE REACTION.

Messrs. J. B. Henderson, D.Sc., and J. S. Nicholson B.Sc., have lately made a comparison between the theoretical and experimental armature reaction of a 30 kw. three-phase alternator in the James Watt Laboratories of the University of Glasgow. The machine has rotating field poles and gave 50 periods per second at 750 revolutions per minute; the normal E.M.F. is 200 volts and the current per phase winding is 87 amperes. An account of their investigation and the method of experimenting employed, together with the results obtained, were given before the Glasgow section of the Institution of Electrical Engineers by the two gentlemen named. They find that the theoretical load curves of the three-phase generator which were calculated in the paper by a method like Blondel's, employing a Fourier analysis of the armature M.M.F.'s, do not agree with the experimental load curves within the limits of the experimental errors, but deviate from them in certain well-defined respects. The limits of experimental error are a small fraction of the maximum deviation, and the deviations themselves are so small as to be negligible in matters of design.

MAGNETIC TESTING.

During the last two years Mr. G. F. C. Searle, M. A., of the Cavendish Laboratory, Cambridge, has been making an investigation of the magnetic treatment of transformer plate and the great influence that it may exert upon the change of induction subsequently found on the reversal of a given magnetic force so as to make ballistic tests of transformer iron liable to great uncertainties. His investigation of these effects was made with the hope of finding how to obtain a definite value for the change of induction due to the reversal of a given force, and of gaining some information as to the effects produced by some selected modes of magnetic treatment upon the change of induction subsequently found on the reversal of a given force. Mr. Searle also examined the effects of the mechanical disturbances involved in the preparation of the specimen for testing, and has considered how far the results obtained with a single specimen may be taken as representative of the magnetic quality of a whole batch of sheets of transformer iron. The work is therefore more or less a critical examination of the use of the ballistic method in magnetic tests of transformer iron, and Mr. Searle himself gave a most exhaustive account of the experiments undertaken and the results obtained in a paper on "Studies in Magnetic Testing," which was read before the Institution of Electrical Engineers in London.

Cause of Vapor Explosions.

An interesting correspondence says the London "Electrical Review," has been proceeding for some time in the "Chemiker Zeitung" on the cause of the occasional explosions of vapors which have taken place at different chemical works. A very inflammable volatile liquid, carbon bisulphide more particularly, has been run through metallic pipes, or through a metallic funnel, into a metallic or non-metallic drum, replacing the air formerly in that vessel. Part of the liquid has evaporated, forming a mixture of vapor and air, which, in the total absence of fire or artificial light, has exploded, and done more or less damage. It has been so difficult to find the proper explanation for this curious phenomenon, that certain writers have suggested that the friction of the passing liquid upon the edges of the funnel or the mouth of the pipe must have generated sufficient electricity to produce a spark, which has immediately fired the explosive mixture.

A more probable, and entirely chemical, explanation of the explosions has now been put forward, which appears to meet all the requirements of the case. According to this view, when a volatile organic liquid of the kind now under consideration, which contains sulphur, either as a part of its nature, or as an impurity, is brought into contact with iron or steel, sulphide of iron is formed. In presence of air this body oxidizes, generating so much heat in the process as to raise the mixture of vapor and air above its inflaming point, when, if it takes fire in a confined situation, it produces the symptons of a gas explosion.

A New System of Train Control.

The Cutler-Hammer Manufacturing Company of Milwaukee, Wis., has recently taken out a patent on a new system of controlling electrically-propelled trains, operating on the multiple unit plan. The principal feature of the invention lies in the fact that both the direction and speed of the driving motors of the entire train are controlled by means of two wires running the entire length of the train, and by use of a controller of about the same size as a standard field regulator for a 3 kw. generator. The two wires constituting the train line are attached at each end of the car to automatic couplings, which enable the cars to be shifted either end to, thus requiring no attention in coupling up so far as the electrical equipment is concerned. The maximum current carried by the two-wire train line is the output of a 3 kw. 110-volt generator when used in connection with six cars equipped with four motors on each car, capable of developing 300 hp. per car.

Electrical Supplies Wanted.

The Bureau of Supplies and Accounts of the Navy Department will open bids on March 7 for furnishing the New York, Boston and other navy yards with the following: Schedule 88, Arc and incandescent lamps; induction coil; wattmeters, wire, conduit and fittings, electrical supplies; schedule 89, motors, dry battery cells, copper conductor; schedule 91, electrical supplies; schedule 92, motors. Blank proposals will be furnished on application to the navy pay office in New York or to the bureau at Washington. Applications should designate the schedules desired by number.

Plant for Electrical Exchange Building.

A contract has been let for equipping the Electrical Exchange Building, 136 Liberty street, New York City, with a 75 hp. and one 40 hp. Buffalo horizontal center crank engine for direct connection to generators of 50 kw. and 25 kw. capacity respectively. The three-wire system will be made use of and it is expected the plant will be in working order about May 1.

Society of Chemical Industry.

The next meeting of the New York Section will be held at the Chemists' Club, 108 West 55th street, on Friday evening, February 24. The following papers will be read: "Tetrachloride of Carbon and its Use as a Solvent in the Differentiation of Bitumen," by C. Richardson and C. N. Forest; "History of Artificial Musk," by H. Schweitzer, and "Tannin and Tanning Materials in Relation to Tariff Classification," by Wilton G. Berry.

The Howard Company Moves.

The Howard Miniature Lamp Company, heretofore located at 221 Canal street, New York City, has removed to more commodius quarters at 58-60 Reade street. Here this well known concern will in the future as it has in the past turn out high grade incandescent lamps.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED FEB. 14, 1905.

Electric Railways and Appliances.

782,405. Trolley. John Martland, Detroit, Mich. Filed Jan. 2, 1903. Renewed Nov 25, 1904.

782,455. Car-Signal System. William Lintern, West Park, O. Filed Nov. 28, 1904.

782,589. Trolley. Benjamin Williams, Columbus, O., assignor of one-half to W. F. Volk, same place. Filed June 17, 1904.

782,652. Insulated Rail-Joint. George L. Hall, New York City, assignor to the Continuous Rail Joint Company of America, Newark, N. J. Filed Jan. 9, 1904.

782,751. Automatic Electric Railway-Signal. William S. Jackson, Hoboken, N. J., assignor of one-half to David Young, Newark, N. J. Filed Jan. 9, 1904.

782,756. Trolley Guard. Edward R. North, Webster Groves, Mo. Filed May 6, 1904.

782,786. Trolley-Pole Controller. Joseph P. Magney, Los Angeles, Cal., assignor to the Magney Manufacturing Company, same place. Filed July 11, 1904.

782,796. Trolley-Switch. Alexander Palmros, Columbus, O., assignor, by mesne assignments, to Joseph A. Jeffrey same place. Original application filed Sept. 24, 1897. Divided and this application filed June 6, 1901. Renewed June 13, 1903.

Electric Lights and Appliances

782,749. Incandescent Electric Lamp. John H. Guest, Brooklyn, N. Y. Filed May 14, 1904.

Electrical Machinery and Apparatus.

782,340. Means for Regulation of Dynamo-Electric Machines. Albert S. Hubbard Greenwich, Conn. Filed Feb. 20, 1902.

782,386. Fraud-Detector for Electric Meters. Wallace W. Fuller, Charleston, S. C. Filed May 20, 1904.

782,593. Mechanism for Operating Electric Motors and Controlling the Speed of Devices Actuated Thereby. Otto C. Britsch, Maspeth N. Y., assignor to David Wald, New York City. Filed May 16, 1904.

782,646. Electrical Drive for Hydro-Extractors, William L. D'Olier, Philadelphia, Pa. Filed July 25, 1903

782,731. Magnetic Controlling Mechanism. Arthur C. Eastwood, Cleveland, O. Filed Aug. 27, 1904.

782 732. Controller for Electric Motors. Arthur C. Eastwood, Cleveland, O. Filed Sept. 14, 1904.

Telephones and Telephone Apparatus.

782,323. Telephone System. Daniel W. Campbell, La Crosse, Wis., assignor to the Vought-Berger Company. Filed June 21, 1904.

782,376. Four-Party-Line Telephone System. Garrison Babcock, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed Nov. 14, 1903.

782,382. Telephone-Exchange System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed May 20, 1903.

782,419. Intercommunicating Telephone-Switch. William H. Rose, Catonsville, Md. Filed Nov. 21, 1904.

782,562. Telephone-Register. Merritt Hitt, Los Angeles, Cal. Filed July 7, 1903.

Miscellaneous.

782,254. Telegraph-Relay. Joseph W. Larish Bridgeport, Conn., assignor to the United Press, New York City. Filed Aug. 18, 1904.

782,308. Electrolytic Apparatus. Arthur Wright, Brighton, Eng. Filed March 23, 1903.

782,311. Electric Display Apparatus. Edmund L. Zalinski, New York City. Filed Sept. 6, 1904.

782,387. Electric Time-Switch. William H. Gerhard, Austin, Tex. Filed Sept. 15, 1904.

782,391. Electric Cable. Albert P. Hanson, Charlottenburg, Germany. Filed March 19, 1904.

782,422. Receiving Apparatus. Harry Shoemaker Jersey City, N. J., assignor to the International Telegraph Construction Company, New York City. Filed Sept. 1, 1904.

782,453. Thermostat. John I. Linler, Aiken, S. C. Filed Feb. 13, 1904.

782,456. System of Electrical Distribution and Control. Edward Lyndon, New York City. Filed March 24, 1904. Renewed Jan. 16, 1905.

782,525. Electrical Water-Heater. Milton H. Shoenberg, San Francisco, Cal., assignor to the Shoenberg Electric Appliance Company, same place. Filed June 30, 1904.

82,550. Electric System. Horace Dowie, Brooklyn, N. Y. Filed April 19, 1904.

782,576. Conduit for Electric Wires. Robert W. Lyle, New York City. Filed May 2, 1903.

THE TELEPHONE WORLD.

Will Not Stand Bell Company's Charges.

A meeting was held about ten days ago in Mt. Clemens, Mich., between a committee from the Business Men's Association, consisting of Messrs. Epley, Daley and Ullrich, and General Manager Land of the Michigan State Telephone Company. The telephone representative showed the local business men a mass of figures tending to show that the company was losing money in Mt. Clemens, but made no proposition to compromise on the rates which are being complained of as excessive. The company's figures showed that for the past year it paid $30,000 for the exchange and improved it by spending $34,000. Depreciation amounted to $16,000, making its present value $48,000. The company desires to make at least 6 per cent. on its investment.

The citizens decided to establish an Independent exchange and secured about $3,000 worth of stock at the meeting.

Iowa Telephone Association.

We are informed by Charles C. Deering, secretary, that the ninth annual meeting of the Iowa Telephone Association will be held at the Chamberlain Hotel in Des Moines March 14, 15 and 16.

The meeting of the association will be held in one of the private dining-rooms on the parlor floor. Telephone manufacturers and supply men will have their exhibits on the fourth floor.

The association banquet will be held Wednesday night, March 15.

Since the union of the Wayne County and Wayne-Monroe (N. Y.) Telephone Companies under one management was effected some six weeks ago so many orders for 'phones have been received in the local telephone office and so many instruments have been installed throughout the village that now scarcely a business house and a very small percentage of residences remain unconnected with central. Patrons of the service are rejoicing at an all night and all day Sunday service. Another great advantage effected by the merger of the two lines is the unlimited free from toll service extending to all districts of the town. Palmyra remains the only one of Wayne's 15 towns in which the Wayne-Monroe telephones are not operative. The telephones recently installed in Lyons are of the new Stromberg make.

A Reading, Pa., dispatch says that farmers who are living near the telephone lines of the Bell and Pennsylvania Telephone Companies are assured of telephone service, the like of which has not been contemplated in the country. Wherever a group of farmers wish the service they will be allowed to build their local line and make connections to the main wires of the companies. This advantage will be accepted by hundreds of farmers within a radius of many miles of Reading. The cost will be very reasonable.

The Michigan Independent Telephone Association has decided to hold its convention this year in Battle Creek, February 23 and 24. The Post Tavern will be the headquarters. About 200 delegates are expected.

New Independent Company in the Field.

An Independent telephone company has been organized in Jefferson County, Tenn., with headquarters at Piedmont, and is called the Piedmont Telephone Company with the following officers: General manager, Dr. William R. West; secretary, W. M. Brooks.

The line will run from Piedmont to Knoxville, Kodak, Strawberry Plains, New Market, Jefferson City and Dandridge. The stock is sold and work has already begun. There will be a general exchange at Piedmont. The company has petitioned the board of mayor and aldermen of Jefferson for a franchise to enter that city to connect with the People's line there. The matter was referred to the ordinance committee and it is expected that the franchise will be granted.

This line will run through some of the best farms and accommodate a large number of farmers through a splendid section of country. The stock is taken by and the line is being built mostly by the farmers, and will put in communication with the business world hundreds of people who have had no telephones. Already orders have been given for about 200 'phones on the line.

The Cass County Telephone Company is being organized at Pequot, Minn., the object being to erect lines that will connect the large farming communities in the southern part of Cass County with some of the villages. Five new connections have recently been made between Hazel Dell and Poplar and more than 30 'phones are now in use. When the telephones were first put in the batteries were intended for only 25 telephones, so that it has been found necessary to put in a switch to handle the increasing business connected with this Independent line. The line will at once be extended from Motley to Pequot by way of Leader. Olaf Olson, county superintendent of schools, and W. H. Hallet are the principal promoters.

At the annual meeting of the stockholders of the Cuyahoga Telephone Company of Cleveland, O., three new directors were elected. They were H. P. McIntosh, of the Guardian Savings & Trust Company; C. W. Wason, who is interested in Cleveland traction properties, and Calvary Morris, of the Morris Coal Company, and president of the Cleveland Trust Company. They take the places of Barney Mahler, T. F. Pomeroy and J. W. Marsh. The other directors were re-elected as were the old officers. This leaves F. S. Dickson at the head of the company as its president. No change was expected, since the record of the officers was an excellent one.

Arrangements have been made to extend the farmers' telephone lines in East Lee, Tyringham, Otis, Becket and Washington, Mass. L. S. Black of Boston has been in these towns arranging for the service, which will be installed at a cost of $1.50 a month, 15 subscribers on a line. The plan is to have the farmers' lines central office in Tyringham. The company is to cover about 40 miles of pole line and will require about 1,600 poles. Connection to the trunk lines will be made at Lee and Westfield.

Complete Long Distance Lines.

The Pittsburg & Allegheny Telephone Company recently announced that the long-distance lines connecting Pittsburg with Northern Central and Western Pennsylvania and also Ohio and West Virginia, which have been in process of construction, are now completed. Direct lines to Wheeling, W. Va., and to Butler have also been completed. Additional lines to Johnstown and Uniontown, Pa., connecting with lines to Baltimore and Philadelphia, are now in process of construction.

An entirely new system of telephone service and a new scale of prices, meaning the expenditure of the proceeds of an $800,000 bond issue, will be installed by the Syracuse (N. Y.) Telephone Company in the near future, if present plans are carried out, according to statements made lately by Ernest I. White, one of the directors and attorney for the company. Mr. White said when questioned about the matter: "We are not positively certain that the improvements will be undertaken, but the prospect is that they will be."

Superintendent West, of the Southern Bell Telephone & Telegraph Company, estimated his loss from the recent storms as between $75,000 and $100,000, and Superintendent Simmons, of the Atlanta Telephone & Telegraph Company, states that the loss of his company is about $10,000.

The Greenville and Kennebec Telephone & Telegraph Company has been organized at Greenville, Me., for the purpose of locating telephone and telegraph lines in the region about the head waters of the Kennebec River, with $10,000 capital stock. The officers are: President, Charles D. Shaw, and treasurer, Henry M. Shaw, both of Greenville.

The local telephone companies of Port Jefferson and Patchogue, N. Y., lately connected their lines and now have complete communication throughout the town of Brookhaven, and expect to make connections very shortly with other local telephone companies on Long Island. The two companies now have about 300 subscribers.

Thomas Taggart, proprietor of the General Hotel, Indianapolis, Ind., announces that he will install a telephone in each of 276 rooms of his hotel.

Telephone Incorporations.

The Saginaw Valley Telephone Company, Saginaw, Mich. Capital stock, $850,000.

The Coshocton County Telephone Company, Coshocton, O. Capital stock, $30,000. Incorporators: Joseph A. Finlay, James L. Beck, J. H Elder, W. D. Kissner and S. C Kissner.

The Bloomer Home Telephone Company, Bloomer, Ill. Capital stock, $5,000.

The Prairie Hall Telephone Company, Lexington, Ill. Capital stock, $4,900. Incorporators: Gilson H. Elder, John A. Moon and George C Elder.

The Sangamon County Telephone Company, Pawnee, Ill. Capital stock, $20,000. Incorporators: H. E. Farnam, B. L. Farnam and Hattie M. Farnam.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Anaheim, Cal.—The city trustees favor voting bonds from $10,000 to $15,000 to enlarge and improve the city electric light and waterworks plants.

Arcanum, O.—The city council will vote March 6 for the construction of an electric light plant and city waterworks.

Boulder, Col.—The Boulder Electric Light & Power Company has asked the city council for a franchise for a period of 25 years.

Branchville, S. C.—This city will install an electric light and power plant. Address William Warren, mayor, or G. M. Noble, clerk.

Carlisle, Ark.—This city is to have electric lights.

Denver, Col.—The Denver Gas & Electric Company will enlarge its plant at the corner of 20th and Blake streets.

Elgin, Ill.—The Elgin Hydraulic Company has under discussion the matter of establishing an electric light and power plant.

Enid, Okla.—The erection of an ice and electric light plant is proposed by J. F. Levors of this city.

Galesburg, Ill.—A resolution was recently passed by the city council which may result in this city furnishing its own electric lights, especially for public buildings.

Hartford, Ky.—Ike C. Adair has been elected president and J. D. Cooper vice-president and general manager of the Kentucky Light & Power Company, a new corporation recently formed to install an electric light plant here.

Hope, Ind.—George S. Cook has secured a franchise to establish an electric light plant here.

Houston, Miss.—This city has voted to issue bonds to the amount of $15,500 for an electric light and waterworks plant. J. M. F. Griffin, city clerk.

Iron River, Wis.—This city and Stanbaugh people are figuring upon building a joint electric light plant.

Kirkwood, Ill.—Dr. J. F. Kyler and J. F. White have been granted an electric light franchise by the city council of Biggsville.

Madill, I. T.—A 20-year franchise has been granted to F. W. Porter of Whitehall, Wis., by the town council for an electric light plant.

Maxville, O.—This city is to have one of the finest electric light plants in this State.

Pittsburg, Kan.—The city council has granted a franchise to Morris Claggitt and others to furnish this city with electric light and the operation of a power plant.

Pontiac, Mich.—A. Jacobs of Detroit will probably erect a gas and electric light plant here in the near future.

Rifle, Col.—It is reported that an electric light plant to cost about $50,000 willbe erected here by A. L. Hackenberger of Dallas, Tex.

Roanoke, Va.—C. H. Stanley, J. C. Moir, H. J. Hartzberger and others have organized a $40,000 company to construct and operate an electric light plant.

Spokane, Wash.—It is reported that the Spokane & Columbia River Railroad Company has purchased a water right which it proposes to develop at an expenditure of $500,000 for the furnishing of electric light for Davenport and other towns.

Sylacauga, Ala.—The contract will soon be let for the erection of the new electric light and waterworks plant, for which bonds to the amount of $24,000 have recently been issued.

Turtle Creek, Pa.—The Rose Electric Light & Power Company has been incorporated with a capital of $20,000 to construct a power house. William L. Ledger is president.

Vidalia, La.—The Vidalia Light & Water Company, of which J. W. Wiggins is manager, will soon commence the construction of its $40,000 electric light plant.

Walnut Ridge, Ark.—S. C. Dowell of this city says that he will erect a $25,000 electric light plant at Pocahontas.

STREET RAILWAYS.

Ardmore, I. T.—The city council has granted to D. E. Lester, R. B. Lester and C. M. Jolner a franchise to construct an electric line. Right of way was given through the principal street of this city.

Aurora, Ill.—An electric line from here to Ottawa is being projected.

Carthage, Mo.—Jasper County is to have two additional electric lines. A. H. Rogers, president of the Southwest Missouri Electric Railroad Company, announces a new line from Webb City to Oronogo and Alba, mining towns, and a franchise has already been asked from the Webb City council for an independent line to extend over the same route. Isaac B. Craig is the latter applicant.

Clintonville, Wis.—Surveys for a new electric passenger and freight double track road, to be known as the Red River Valley Electric Railway, are nearing completion and it is expected that cars will be running by July 1. The road will begin here and end at Antigo, the line passing through Eland Junction, Matoon and Phlox. It is said that the road may also be extended to the Republic, Mich., iron mines. F. C. Delano of Philadelphia is chairman of the board of directors.

Durant, Miss,—The first permanent stake in the new electric interurban railways running from here to Lexington and Yazoo City has been driven by Mayor J. G. Hamilton. Chester Jones and W. O. Glines are the promoters of these railways.

Excelsior, Minn.—A formal application to the village council for an exclusive frachise to construct electric lines within this village has been made by Col. N. U. Hord of Philadelphia.

Grinnell, Ia.—O. K. Cole is promoting a company to build an interurban electric road out of this place.

Hopkins, Minn.—B. J. Phelps and E. Kenaston, who propose to constuct a trolley line from Minneapolis to Mankato, will ask the Hopkins city council for a franchise to enter this city.

Moberly, Mo.—This city is to have an electric railway. Joseph Clark, representative of H. S. Ramsey of St. Louis, has been here making preparations to build a power house.

Mexico City, Mex.—The Electrical Development Company of Mexico, which is controlled by the Mackenzie & Wann Syndicate, purposes to buy up the tramway lines in different cities of Mexico and install electric systems in each.

Vancouver, B. C.—The British Columbia Electric Railway Company will erect an electric line between this city and Stevenson on the Fraser River.

Wabash, Ind.—The Fort Wayne & Wabash Valley Traction Company has authorized a bond issue of $1,000,000 to be used in building a central power plant.

West Middlesex, Pa.—The Shenango Traction Company has been granted a right of way by the council of this city. Wheatland, Clarksville and Greenville have also granted franchises, and when the Sharon council takes favorable action the company will have a clear right of way from Cambridge Springs to New Castle. The road will cost $1,500,000.

POWER PLANTS.

Dillon, Col.—W. H. Foster of this city has purchased a site and will erect a large electric power plant.

Martinsburg, W. Va.—Capitalists of Washington and Baltimore, headed by Stevenson A. Williams, are said to be organizing a new stock company for the purpose of purchasing the old pulp mills and getting possession of the water power at Harper's Ferry, W. Va., where the erection of a big electric power plant is contemplated. It is said that stock to the amount of $150,000 has already been subscribed, and that the venture has assumed definite shape.

Mexico City, Mex.—A large electric generating plant is to be established in this vicinity by the Mexican-American Power Company, which was recently organized with a capital stock of $150,000. G. Stuart Simmons of New York is interested in the enterprise.

Morelia, Mex.—The government of the State of Michoacan has granted a concession to a syndicate of capitalists for the establishment of an electric power plant at a point on the San Pedro River in this State. The water of that river will be used to generate the electrical energy.

BIDS WANTED.

Birmingham, Ala.—The Eureka Foundry & Machine Company of this city wants prices on electric motors.

Camden, Tenn.—L. A. Wyatt, superintendent of the new electric light company, wants prices on a 700-light dynamo, direct current, two-wire, 220-volt.

Corydon, Ky.—The Corydon Milling Company wants prices on a generator to operate 300 to4 00 incandescent lights and a 50 hp. motor.

Holly Ridge, N. C.—A. M. Prince of this place is in the market for a 40 to 50 hp. engine and a 75 to 100 hp. boiler.

San Antonio, Tex.—J. B. Trescott, 406 Dallas street, this city, is in the market for one 150 hp. steam turbine or rotary engine.

Spray, N. C.—S. H. Marshall is in the market for one good second-hand 300 hp. Corliss engine.

Washington, D. C.—Sealed proposals will be received at the office of the commissioners until March 20 for supplying an electric generating plant for a sewerage pumping station. Address any of the following commissioners: Henry B. F. MacFarland, Henry L. West and John Biddle.

Waynesboro, Ga.—J. I. Linler of this city is in the market for a 50 or 60 kw. direct current generator.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15¼@15⅜c.; casting, 14⅞@15c.

The annual meeting of the Electric Storage Battery Company will be held March 15.

The Commercial Electric Vehicle Company of Jersey City, capital $1,000,000, has been incorporated.

The Toledo (O.) Urban & Interurban Railway, an electric line, has issued $1,000,000 bonds for construction.

The copper producing companies state they are assured of a 15-cent market for the first 6 months of the current calendar year.

Earnings of the Philadelphia Electric Company for January show an increase over the corresponding month of last year of $58,000.

The City & Suburban (Bell) Telephone Company of Cincinnati has voted to increase its capital stock from $4,000,000 to $5,000,000 to take in suburban lines.

At the annual meeting of the Marconi Wireless Telegraph Company, in London, England, it was announced that the net profits of the company for 1904 were $63,405.

The Bullock Electric Company of Cincinnati, the property of which is leased to the Allis-Chalmers Company, has been incorporated in Ohio with a capital of $2,500,000.

It is said that a syndicate of bankers, which has lately been prominent in acquiring electric lighting properties, has made an offer to lease the Electric Company of America of Philadelphia.

Announcement is made that a contract for electrical equipment, amounting to $175,000, has been awarded to the National Electric Company of Milwaukee by the Union Electric Light & Power Company of St. Louis.

The earnings of the Chicago Edison Company are said to be larger this winter than ever and the company is extending its field for supplying power to small manufacturing concerns. That business alone is said to have doubled within the last year.

At a special meeting of the stockholders of the Boston & Worcester Electric Companies, the trustees were authorized to issue 3,500 additional shares of common and 3,000 additional shares of preferred stock for the purpose of paying off the total indebtedness of the company.

Through its acquisition jointly with Delaware & Hudson of the Schenectady Railway Company the New York Central now holds firmly the control of the trolley situation up New York State. It is not now practicable for independent and competing electric lines to parallel New York Central tracks.

The Consolidated Gas, Electric Light & Power Company of Baltimore, a merger of the Consolidated Gas Company, the United Electric Light & Power Company and the Wenstrom Electric Company of that city, has been organized with Davies Warfield, president of the Continental Trust Company, as chairman of the new board of directors. The capitalization of the company includes 4½ per cent. bonds, $15,000,000; 6 per cent. prior lien cumulative stock, $700,000; 5 per cent. cumulative preferred stock, $6,000,000; common stock, $6,000,000. The mortgage of the Consolidated Gas, Electric Light & Power Company to the Continental Trust Company, trustee, provides for an authorized issue of $15,000,000, 4½ per cent. 30-year gold bonds, $8,639,000 of which will be reserved in the treasury for the future requirements of the company.

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price Feb. 18
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	173
Metropolitan Street Railway	121⅜
Metropolitan Securities	81¼
Ninth Avenue	197
Third Avenue	182¼
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	62¼
Interborough Rapid Transit	116
New Orleans Railway	3⅛
Public Service Corporation (New Jersey)	141
Philadelphia.	
Consolidated Traction of New Jersey	82½
Philadelphia Traction	100½
Union Traction	58⅞
Boston.	
Boston Elevated	156
Massachusetts Electric Companies, com	15¼
do. do. do. pref.	57
West End Street, com	97
do. do. do. pref.	115¼
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	12
do. do. pref.	51

ELECTRIC MANUFACTURING COMPANIES' STOCKS.

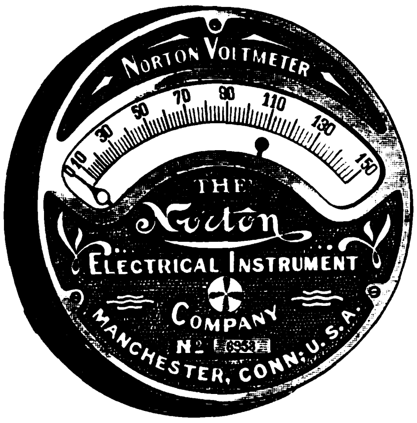
Name.	Closing price Feb. 18
New York City.	
Allis-Chalmers, com	17⅞
do. pref.	67
Electric Boat, com	40½
do. do. pref.	82
Electric Lead Reduction	½
Electric Vehicle, com	14½
do. do. pref.	25
Westinghouse, com	180
do. pref.	192
General Electric	186¾
Boston.	
Edison Electric Illuminating	251
General Electric	187
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	162
National Carbon, com	42⅜
do. do. pref.	112¾
Philadelphia.	
Electric Company of America	12
Electric Storage Battery, com	82½
do. do. do. pref.	82½

TELEPHONE AND TELEGRAPH STOCKS.

Name.	Closing price Feb. 18
Boston.	
American Telephone & Telegraph Company	144½
Western Telephone Company	22½
New England Telephone Company	134
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210¼
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93⅝
Chicago Telephone Company	140

MISCELLANEOUS STOCKS.

Name.	Closing price Feb. 18
Otis Elevator Company	49⅞
Consolidated Car Heating	64
Standard Underground Cable	200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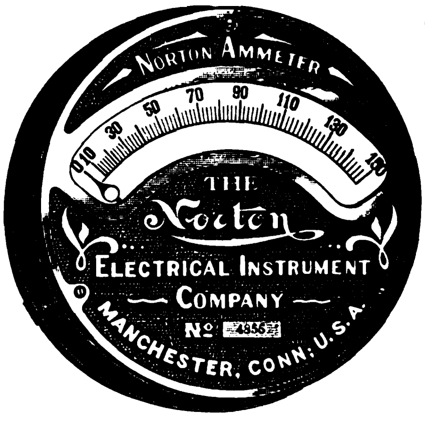
MANCHESTER, CONN; U.S.A.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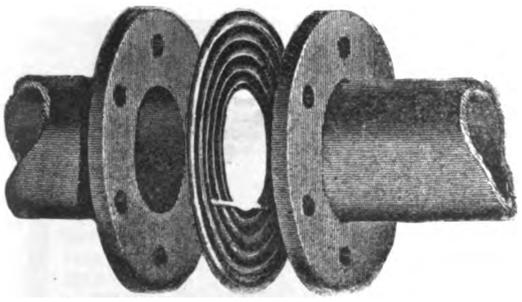

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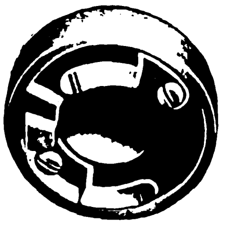

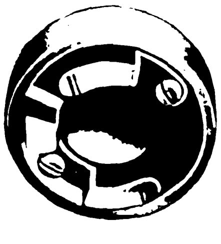

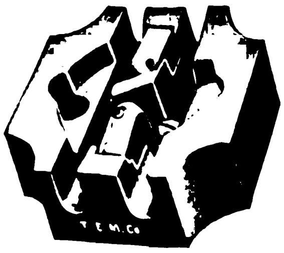

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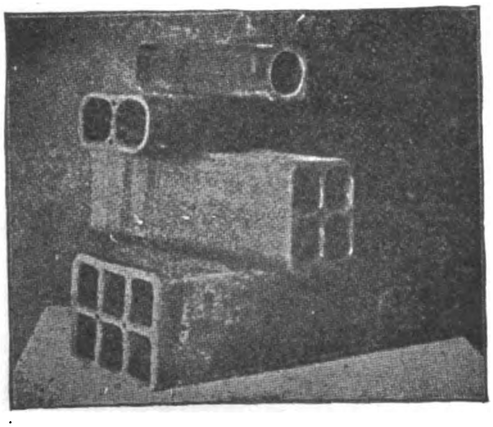

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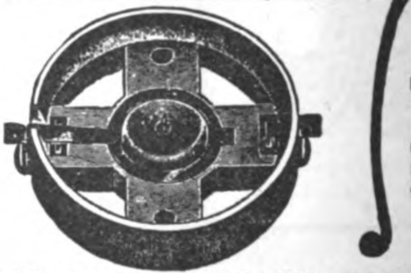

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ELECTRICITY.

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EDITORIAL NOTES.

Facts and Figures that are Conclusive.

In view of the fact that New York City is committed to refuse burning for electric light, a few words as to what has and what has not been accomplished in this line in England, where the practice was originally started, may prove interesting.

Probably the first attempt to cremate refuse in a specially constructed furnace occurred at Paddington in England in 1870 and proved a complete failure. In 1876 a furnace for burning refuse, called by the inventor a "destructor," was erected at Manchester. This destructor proved successful so far as it went, in that it destroyed the refuse without it being necessary to burn an undue amount of coal and without the gases given off proving too obnoxious to the surrounding neighborhood.

It was not, however, until 1896 that a boiler was attached to the destructor furnace with a view to generating steam for power purposes. In that year the town of Oldham, finding that more steam was generated than could be utilized in the destructor works adjoining the electric light station, a steam main was carried into the latter and electricity from refuse-raised steam became an accomplished fact.

With Oldham as an example a number of destructor plants then shortly sprang up in various parts of England, and notably in the vestry of Shoreditch in London.

Elsewhere in this issue will be found an article on the subject of electricity production from refuse, especially prepared for ELECTRICITY by its London correspondent. The facts and figures given in this article were carefully gathered, sifted and digested with a view to ascertaining whether it pays and how well it pays to utilize refuse as fuel for steam-producing purposes. The conclusion reached may be summed up as follows: That the incineration of public and private refuse is the right process, but that the benefit obtainable from an electric generation point of view, though well worth having, must not be figured out too generously or disappointment will follow.

This conclusion, the result of careful study of facts and figures, should be considered and taken into account by the heads of our local municipal government before committing the city to a wholesale expenditure of money for garbage destructor electric light plants, which in the end may entail an enormous financial waste.

* * *

The People Awaking.

Protest against the exorbitant rates charged by the New York Telephone Company is still being made. The people of this city are at last really beginning to realize that the charges for service are too high, in fact much higher than in any other community in the country. That such is the case may be inferred from the fact that the rate for 1,200 telephone calls in Chicago is $105 a year, $91 a year for the same number of calls in Boston, and $87 in Philadelphia, where active competition with an independent company exists. In New York the local telephone company demands $1,100 a year for similar service.

ELECTRICITY has been endeavoring for the past eight years to bring about a more equitable schedule of telephone rates and has pointed out time and again in these columns that the people of this city were being imposed upon. It is therefore with pleasure that we learn that a joint public hearing has been fixed for

March 7, at Albany, upon a resolution for a legislative investigation of the monopoly's methods and charges. Meanwhile it is stated that the Board of Trade and Transportation may follow up its call for an investigation by bringing its influence to bear directly upon leading members of the dominant party in the Legislature. It is sincerely to be hoped in the interest of the people that the proposed investigation will not be sidetracked.

* * *

Electricity and Industrial Development.

A writer of novels, in commenting in the form of a toast, upon Edison's work, said: "Hail to Edison, Wizard of the Nineteenth Century and Monarch of the Twentieth." Perhaps this idea could now be construed differently without detracting in the least from the reputation of this inventor, by saying "Hail to Electricity, Wizard of the Nineteenth Century and Monarch of the Twentieth."

The influence of electricity upon industrial development has not been limited to a few widely scattered cases, but has become emphasized of late in connection with old and new enterprises of such a variety and such magnitude that it may well be accepted as an established fact that electricity has become monarch of the twentieth century.

Brilliant work has been done in the last decade which has so stimulated the field of electrical activities that electrical invention has overshadowed all other human achievements. The list of the new provinces representing this gigantic empire, which have been recently invaded and attacked are railroads, lighting, power, mining, signaling, telephoning, medicine and varied manufacturing. It is easy to glide over these subjects with but a passing interest, but the thoughtful men will see more than mere names in this incomplete list. Under the head of "varied manufacturing" the development through the use, if not entirely originated by electricity, is really sensational. Take the acetylene interests or the carborundum interests. Take the aluminum business alone with its many ramifications. Why, it seems as though the surface of things has only been scratched and the rich finds below are waiting for us.

The white goods manufacturers use electric power to the exclusion of all else; and those trades which are in any respect allied, and in which sewing machines are used, depend upon the motor for the normal output of their factories. The machine shops use the electric drive with individual control for each machine. The 40 per cent. loss in belts and shafting has gone and electricity, on tap whenever required, has been the means of removing unsightliness, uncleanliness, noise and inefficiency. In the pressure of manufacturing and business life, devices are required which do things quickly and well. The telephone and the telegraph are now regarded as indispensable. What a pitiable civilization this would seem without them—yet we have just taken the first full breath of freedom in this new atmosphere of electrical and mechanical progressiveness.

It is a fact that could hardly meet with denial from our historians of economic advancement, that industrialism and the force that is leavening it are natural associates at this era. There are some that step from behind the scenes and say, "Give us more inventions and there will be more workers, more consumers and therefore more wealth and prosperity."

The contributions of those who have been and are engaged in the origination, development and crystallization of useful ideas have come mainly from electricians. Great factories have grown as it were over night to yield the fruit of inventive genius, and it can be truly said that one million workers in the United States are now toiling as proof of the idea that associates electricity with our best industrial development.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The city council of Elgin, Ill., has voted to lease the municipal lighting plant to the Elgin, Aurora & Southern Traction Company for 10 years. The municipal lighting plant was a losing investment for that city.

◆

It is announced that Signor Marconi will come to this country on his wedding tour, sailing March 18. While he is here, it is said, he will install another wireless station by which he hopes to greatly improve the wireless system.

◆

A large deficit is bothering the officials of Hamilton, O., as a result of that city owning its own electric light plant.

◆

Mr. Homer E. Niesz, editor of the Question Box for the National Electric Light Association, informs us that the first list of questions is being sent out to all electric light companies in the United States and Canada, also to electrical manufacturers, engineers, dealers and technical colleges. This list contains 444 questions, covering 26 headings. Answers are desired from all who are competent to reply to any one or more of the questions, and these replies should be sent to Mr. Niesz, 139 Adams street, Chicago, within 30 days.

◆

The executive committee of the American Street Railway Association decided to hold the next convention in Philadelphia during the week beginning September 24, at the Bellevue-Stratford Hotel.

◆

Mr. Lewis B. Stillwell, electrical director of the Interborough Rapid Transit Company, New York City, in a recent address said that "electrification of the elevated lines in New York has increased their capacity by one-third and has decreased by one-fifth the time spent on trains by the average passenger. It has demonstrated that the cost of maintenance of electrical equipment of rolling stock is materially less than that of steam equipment and it has proved that electricity can render more reliable service than steam."

◆

United States Consul-General Holloway, of Halifax, Nova Scotia, reports that $250,000 will be spent for improvements on the Welland Canal. Several bridges are to be rebuilt, and the canal is to be lighted by electricity, lights being placed every 200 feet.

◆

At the meeting of the executive committee of the International Association of Municipal Electricians, held at Erie, Pa., the date for the convention was set for August 29, 30 and 31.

◆

Prof. Ernest Rutherford, of McGill University, Montreal, has been appointed Silliman lecturer at Yale University for 1905.

◆

It is now proposed to fit lightships Nos. 71 and 72, which do duty on the dangerous Diamond shoals on the coast of North Carolina, with wireless telegraph outfits, and before No. 71, which is now at Baltimore, returns to the station, it is more than probable she will have an outfit aboard with experts to run it. The installation of wireless telegraphy aboard the lightships is a part of the strategical scheme of the Navy Department to connect the entire Atlantic coast by wireless telegraphy. The wireless service aboard the lightships on the Diamond shoals would be valuable, as quick notice could then be given of vessels in distress and quick succor could reach them.

GARBAGE DISPOSAL AND ELECTRICITY PRODUCTION.

A POINTER FOR NEW YORK AND OTHER LARGE CITIES.

(From our London Correspondent.)

For several years past criticism has been very freely showered upon the municipal ownership and operation of electric lighting and other systems in England. And that a great deal of this criticism is justifiable is proved up to the hilt by the abundant evidence that is forthcoming from many parts of the United Kingdom to the effect that a very large percentage of the undertakings are not working at a profit to the ratepayer. The criticism, however, has not been so effective in its attempted application to the larger cities, such as Glasgow, Liverpool, Sheffield, and so on; it has mainly effected the smaller towns and districts, and as a result a number of these have been only too willing to pass on the responsibilities of electricity supply to the larger power distribution companies who supply many towns within a wide area, or to companies owning a dozen or more concessions situated many miles apart, but all under one central and therefore economical management. There is one branch of municipal enterprise which has been particularly free from attack, and that is refuse destruction by the process of incineration. There is a feeling that matters affecting the public health in any particular degree are best left in the hands of the public authority. The progress has been really remarkable. The dust destructor as a means of getting rid of objectionable matter in a sanitary way is universally regarded as the best means yet produced; but, though there has been no difference of opinion, and no criticism worth mentioning on that point, there has been criticism and there has been diversity of opinion as to the benefit likely to accrue from the combination of the destructor with an electricity generating station.

The correct attitude, and one which has been adopted by many English electrical engineers, may be described thus: The primary object of refuse destruction is the disposal, in a sanitary manner, and rendering innocuous all waste materials collected from the private house dust-bins and trade refuse. If, at the same time, not only can this object be realized, but some useful product obtained by so doing, without any corresponding disadvantages or drawbacks, the cost can be materially reduced, and the financial aspect of the question becomes more favorable.

Speaking approximately, 200 towns at least in the United Kingdom and Ireland have adopted refuse destructors. We think we shall be on the low side if we say that about one-third of these have adopted the combined idea—the electricity works plant receiving the aid of the steam raised from the refuse burning. The progress that has been made during the past five or six years will be realized when we say that previous to the year 1899 there were only two or three combined undertakings in operation. The majority of the destructors so combined are of the Meldrum type, most of the remainder being of the Horsfall design.

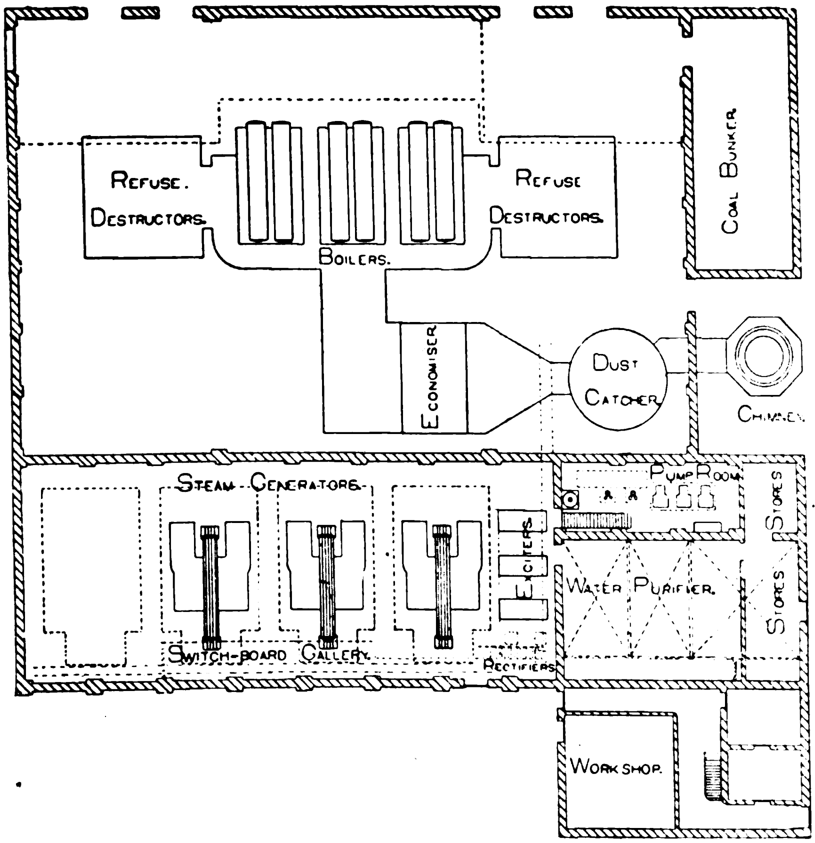
There has been much discussion among English electrical engineers recently as to the results which have been obtained, and the figures which have been put forward by some experts have been so severely handled by others that it is not the easiest thing in the world to say which plants have actually recorded the best performances. A test made by the National Boiler Insurance Company of a Meldrum plant of fairly large size at Woolwich, showed that during the evening hours, when the electrical department could use all the steam produced by the destructor, the output of current was just about 100 board of trade units per ton of refuse burned. Messrs. Meldrum, in summarizing the results of hundreds of tests made by them, show that with ordinary average English town's refuse the Meldrum destructors will produce from 1½ to 2 pounds of steam per pound of refuse, proving that the utilization of this power to the utmost extent for municipal purposes is a matter of great importance, more especially, as we have said, now that destruction of garbage by fire is becoming considered an almost absolute necessity in most, if not all, leading cities and towns in England, and many on the European Continent, and others in South Africa, etc.

Perhaps we may now mention a plant of the Horsfall type. Let us take that of Fulham, where about four years' experience has been obtained of the working of 12 cells of the Back-to-Back top feed type. The refuse to be destroyed every 24 hours was 120 tons and the total horse power available from the combustion of this refuse was 600 IHP. The cells are arranged in two groups of six each on either side of six Babcock & Wilcox boilers. The tipping floor is arranged to allow of the storage of a considerable amount of refuse, so that the working of the plant may be continued without interruption. There are not wanting experts, who, however, offer strong criticism of any extensive storing of refuse because it is unmistakably insanitary. Access to the tipping floor at Fulham is obtained by means of an inclined roadway, at the foot of which all refuse received is weighed and a record kept. Each boiler has a heating surface of 1,284 square feet. The destructor gases are led into each of the boilers by means of an opening in front of the bridge, the flue to this opening being provided with a suitable damper so that the boiler may at will be heated from the destructor or fed with coal. It was expected when this plant was put in that the electricity department would be saved the cost of 2,000 tons of coal per annum. The calorific value of the Fulham refuse was said to be one-twentieth that of good steam coal. With regard to the results obtained from this system, Mr. A. J. Fuller, the borough electrical engineer, asserts that he is now getting from 50 to 70 electrical units per ton of refuse. In comparing this with the figure obtained at Woolwich it must be borne in mind that the 100 units there stated were secured at the evening "peak of the load" hours, not an average.

It is hardly necessary in facing the position of matters as they stand to-day to mention what was done several years ago when pioneering plants were put down at Shoreditch, St. Pancras, Ealing, etc. In the putting down of such plants to-day engineers and others have profited by the early experimental experience of these systems, which were kept working for a time and were subsequently found to be of no benefit to the electric light and power plant, and in at least two cases were discarded. Like all things, there has in this case had to be a trial and error stage from which we seem to have now emerged.

Not very long ago one of the important borough councils of London instituted through its chief electrical engineer (Mr. G. G. Bell), and its surveyor (Mr. Mair), a very full inquiry into the wisdom or otherwise of adopting a destructor. The report has some interesting points which have perhaps some bearing on the position which has arisen in New York in connection with the proposed municipal electric lighting and destructor scheme, and we are enabled by the courtesy of Mr. Bell to make some extracts from his statement:

"In the first place, there is no doubt whatever that a proper system of refuse destruction is the most sanitary method of dealing with the house bin refuse collected from large communities, as it can be dealt with close at hand, thus avoiding the risks and cost of transit to the dust shoots which must of necessity be some distance from the large centers of population. The question of cost, however, is to a very large extent the ruling factor, and as the available shoots near at hand are gradually filled up this simple method of dealing with the matter becomes more and more expensive, although from a sanitary point of view it does not materially affect the persons whose refuse is carted away. Dust destructors therefore really affect the community at large, and if the cost of dealing with our refuse by means of a dust destructor is heavier than by sending it away we are paying this extra money simply for a more ideal state of affairs.



General Arrangement of Destructor Plant at Fulham.

"The perfect dust destructor has not yet been designed, and should be a combination of the following points, but there are some very good approaches to it upon the market:

"1. Perfect cremation of the refuse so that there can be no offensive nuisance from partly burned gases.

"2. Must be capable of dealing with the refuse immediately it is delivered, so that it is not necessary to store same as it quickly becomes offensive under these conditions.

"3. No nuisance to the surrounding neighborhood through fine dust or grit being distributed from the chimney stack.

"4. The furnace temperature should be so great that the residue is melted and forms hard clinker which then becomes a useful by-product.

"None of these points should be sacrificed in order that the refuse should be used instead of coal for any useful purpose, and if these points can be fully met and any surplus heat used for generating steam, then this steam may and should be used for driving the necessary machinery required in the destruction of the refuse, and we believe that there would be very little, if any, heat available for any other useful purpose.

"It would perhaps be as well to examine the conditions which prevail at Hammersmith and ascertain the cost of erecting and working a destructor, and also see if any useful purpose could be served by the apparatus after its true functions have been carried out. The actual amount of dust bin and trade refuse dealt with last year was approximately 28,000 tons, but as the population of the borough is continually increasing, any destructor erected should be capable of dealing with 30,000 to 35,000 tons per annum, which taking 300 working days in the year will give an average of about 100 tons daily. The cost of the necessary dust destructor, as well as tipping floors, boilers, dust catcher, buildings and chimney, would be about £18,000, to which must be added the cost of the land. The area required would be approximately one acre, as provision must be made for a necessary inclined approach road, stores and other buildings.

"When the refuse has been tipped into the destructor cell this is not the end, as there is a very heavy residue to be dealt with, which varies from 25 to nearly 50 per cent. of the total quantity placed in the cell. This must be disposed of in some manner or other as rapidly as it is made, and where building operations are in active progress or a large number of new roads and streets are being made up in the district it might be disposed of, but in our case, where sand is abundant and the number of new roads to be made is extremely small, we believe there would be difficulty in disposing of approximately 10,000 tons of clinker without barging away.

"To deal with the refuse by the destructor would cost £5,699 per annum including financial charges but the cost of barging away dust at the present time is 2s. 7d. per ton, which at 30,000 tons per annum equals £3,875, showing an increase of £1,824 per annum.

"Of course it is possible to use the hard clinker for manufacturing artificial stones for paving, but the plant necessary to do this, i. e., mills, crushers, hydraulic press, etc., would cost a further £2,000 before we could deal with this clinker satisfactorily and economically. Taking it for granted that we should be able to get rid of the whole of the clinker, the question arises as to whether any surplus steam which the destructor would generate could be utilized for any useful purpose. This entirely depends upon the amount of steam and the steadiness at which the supply can be maintained, as of course an intermittent supply would not be of any use from a commercial point of view. The question of combining destruction and electricity generation is one turning upon the calorific value of the refuse, and the position which Hammersmith occupies does not justify one in looking for a very high calorific value for the following reason: It is not the center of any very large industrial activity, so that the amount of trade refuse is absolutely a negligible quantity; it is not the center of a rich residential district, so that the amount of combustible material in the house dust bins is reduced by the residents to the lowest possible denomination. An examination of the refuse tipped will bear this out, and in fact we are afraid that in order to obtain a sufficiently high temperature to insure perfect cremation of the gases it would perhaps be necessary to add a little coal to the refuse to obtain this result.

"If we are fortunate enough to burn the refuse without the aid of coal then the surplus heat, after driving the necessary plant for producing the forced draught, lighting the building, driving any artificial stone machinery, etc., will be such a negligible quantity that it is not safe to allow any credit for this in making out the estimates. Taking the average cost per ton, as previously shown, we arrive at a total cost of 3s. 9½d., which we think is a fair estimate, and may be taken as the average cost.

"The actual ascertained cost at Fulham is 3s. 7d. per ton, before, however, allowing a sufficient sum for depreciation, and working a more expensive plant suitable for assisting the electric light works.

"Upon examination of the annual returns of six London municipal electric light stations, three of these having the assistance of destructors and three with coal only, the following comparison shows the value of a dust destructor: Capital expenditure per kilowatt of non-destructor stations, £80; capital expenditure per kilowatt of destructor stations, £118. The working costs of non-destructor stations is 2d. per unit higher than the destructor stations, which, upon 5,774,644 units (their total output) represents £4,895. The extra cost of the capital involved to effect that saving is, apparently at 5 per cent., £7,395, showing a net loss of £2,500 per annum as the cost of combining dust destructors and electric light stations.

"Turning again to the Fulham result, the resident engineer reports that the value of the fuel saved by using dust was £2,260 per annum which, however, we find would be turned into a loss of about £200 if a proper amount were set aside for the depreciation of the special plant.

"We have arrived at the following conclusions: (1) That barging away is more economical at the present time; (2) that the refuse has not sufficient calorific value to justify the combination of a dust destructor with the electricity works; (3) that there is every probability that the cost of cremation of refuse will greatly decrease, whereas the cost of barging is more likely to increase."

The exponents of the cause of refuse destruction in England have themselves thrown cold water upon the wonderful claims that some advocates of the combination have set up, and we cannot do better than quote in this connection the tement of Mr. W. F. Goodrich, one of ding authorities on the question. t the harm done years ago by rdinary claims regarding the gold in the dust-heap" has had its effect ever since. Results in power production were prophesied which have not yet and never will be obtained. The modern destructor has an excellent record, but it has its limits."

The conclusion of the matter still is that the incineration of public and private refuse is the right process, but the benefit obtainable from an electric generation point of view, though well worth having, must not be figured out too generously or disappointment will follow.

ENGLISH FIRE ENGINE PORTABLE ELECTRIC LIGHT PLANT OPERATED WITH LIQUID FUEL.

BY FRANK C. PERKINS.

The accompanying illustrations and drawings show the details of construction and method of operating a new English portable electric light plant for fire department service, with liquid fuel. This equipment was constructed for the Liverpool fire brigade to meet its needs, as indicated by the chief superintendent, Mr. Thomas. This fire engine electric light plant was built by Messrs. Merryweather & Sons, of Long Acre, London, and is equipped with a complete telephone system. The direct current dynamo utilized is of the inclosed type, mounted, as shown, on top of the outfit, the lamps, provided with handles and guards, being connected to flexible cables on reels. The drawings show the details of a special burner for utilizing liquid fuel stored in the tanks, designed by Mr. I. I. Kermode, C. E. A jet of steam from the boiler from a valve at A, is used to pulverize or spray the oil in this burner. A guage, D, shows the pressure under which the jet is operating, and a valve, B, provides for adjusting this pressure. One of the tanks on the engine is used for feed-water and the other, H, for the oil supply through the valve, E, passing to the burner entering the furnace at J, as indicated in the drawing. The drawings of the burner indicate that the oil will have a whirling motion, caused by the construction of the oil valve stem. The oil supply is entirely steam jacketed, as will be noted in the drawing, which indica that the steam enters around the

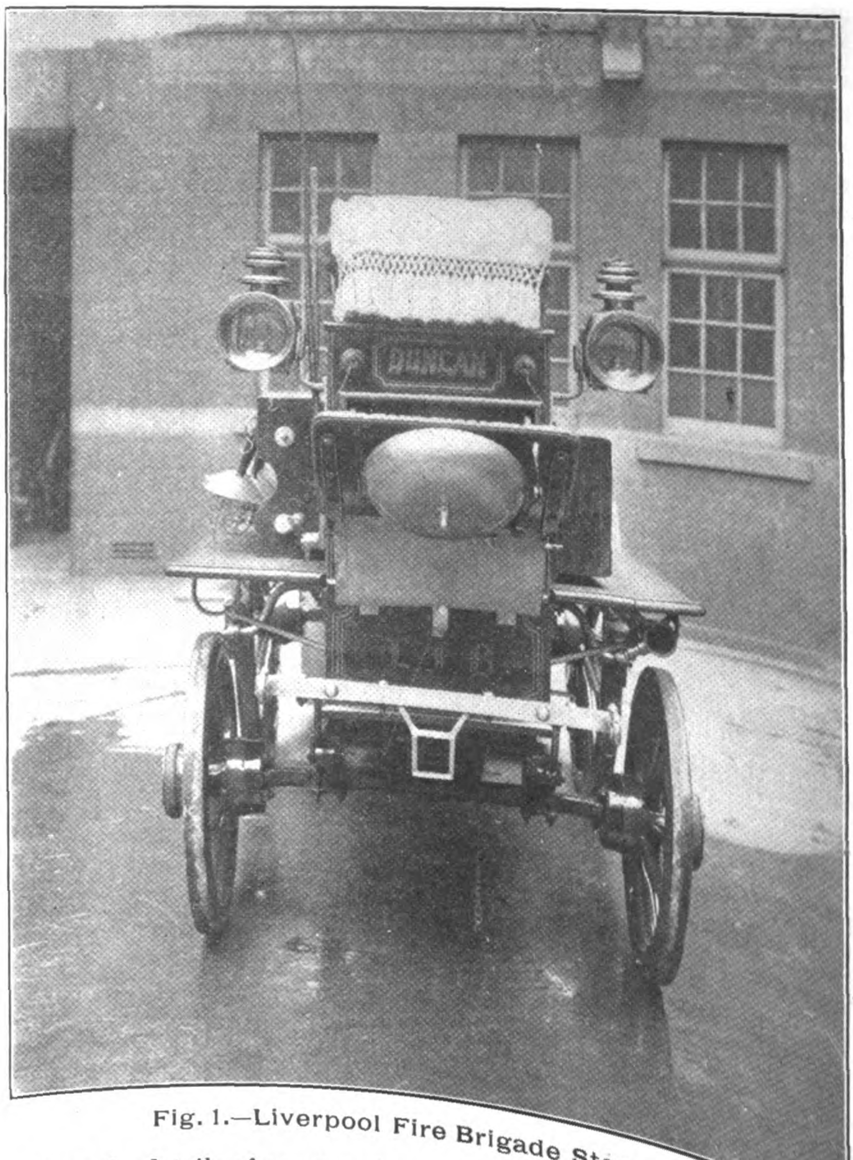


Fig. 1.—Liverpool Fire Brigade Steamer.

cone and then passes into the cylindrical portion through slots. The cylindrical portion fits in the hollow of the air cone, the latter being fitted with spiral guides and the air drawn in through the same by the action of the steam. The amount of air drawn in is adjusted by closing or opening the spaces provided for the purpose. The range of the burner is said to be such that the flame can be turned down so as to barely keep the boiler working, and it is claimed that little or no smoke is sent out of the stack, as complete combustion is obtained.

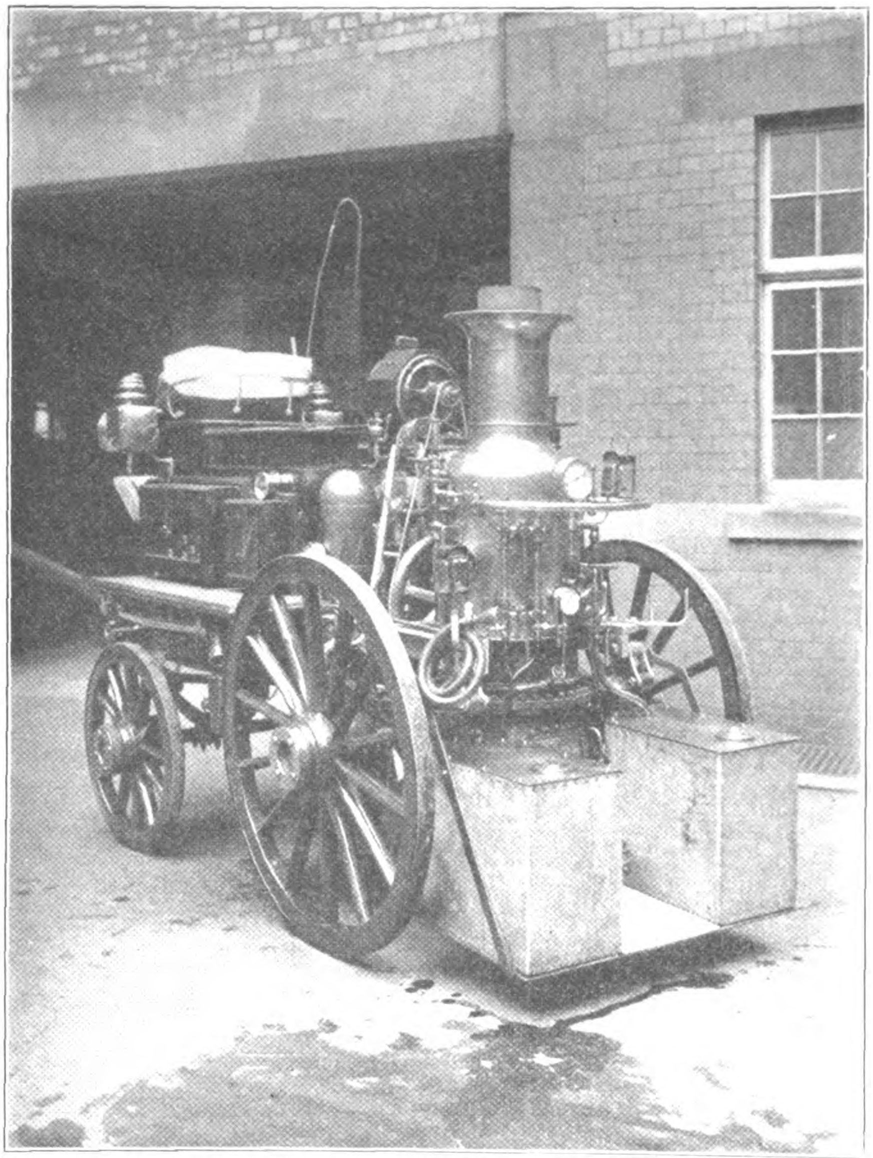


Fig. 2.—Liverpool Fire Brigade Horse-drawn Fire Engine.

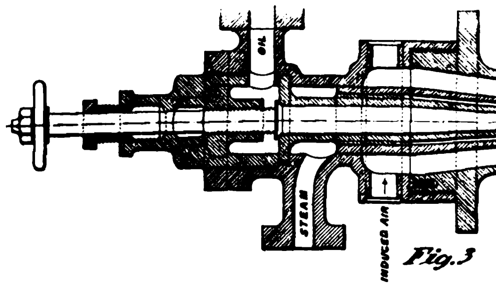


Fig.3

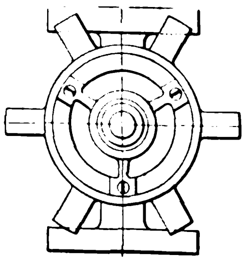


Fig.4

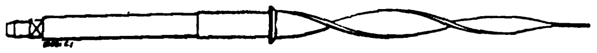


Fig. 5.

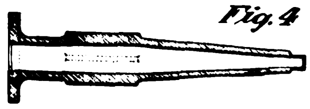


Fig. 6.

The burners work with a steam pressure of 16 to 20 pounds per square inch, but until the pressure has reached 10 or 15 pounds per square inch the oil burner cannot be used, and the fire must therefore be started with solid fuel in the ordinary way. However, by adding to the engine a cylinder containing compressed gas or air, this drawback has been overcome, as with this compressed air or gas the oil burner can be started and kept at work until the steam pressure has risen sufficiently for it to work the burner. The gas is compressed to a pressure of 100 atmospheres and is carried in an ordinary gas cylinder, about 18 inches long and 5½ inches in diameter, containing 20 cubic feet of air or coal gas. With this addition the oil fire can be started immediately and there is thus a saving of time needed to get up steam, which can be raised to 40 pounds pressure in 8 minutes.

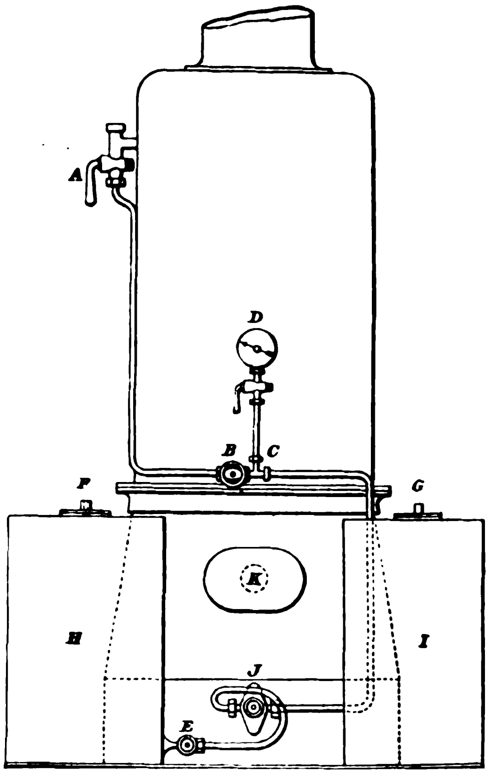


Fig. 7.

When 15 pounds of steam is on the boiler the gas is shut off and steam used direct from the boiler. The cylinder is filled inside the feed-water tank, which is at the right hand side in the illustration. For fire brigades, where steam is not kept up on the boiler continuously, the fitting is invaluable as the charge stands ready for instant use and it is available for any length of time provided there is no leakage. This fitting is especially

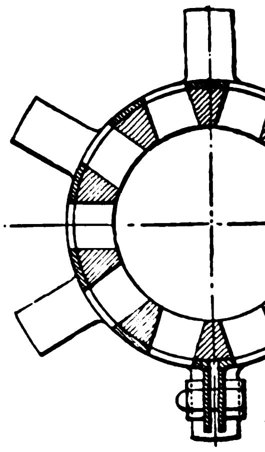


Fig.8

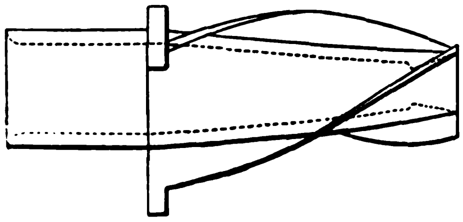


Fig. 9.

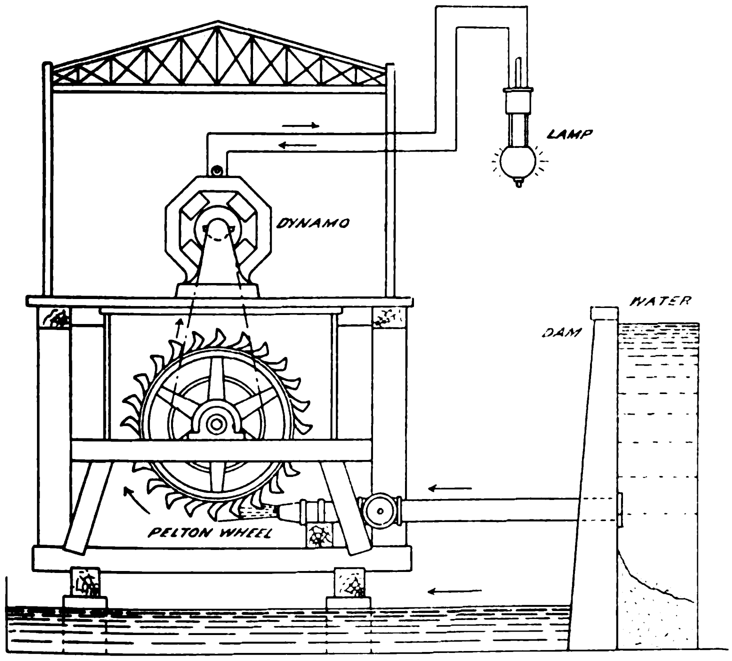
valuable for suburban or private fire brigades where an engine is seldom used. The Liverpool fire brigade is supposed to be the most thoroughly equipped brigade in the world. Its oil-fired engines are general favorites, being in constant use and always ready with steam up.

ELECTRICITY LEAFLETS.

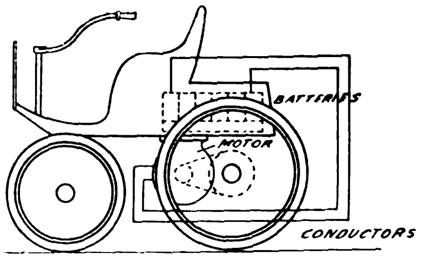
BY NEWTON HARRISON, E. E.

THE MOTOR.

Oersted's Discovery.—The reversibility of dynamos and motors operated by a continuous current is of enormous advantage in the practice of electrical engineering. The same is true of single-phase generators which, of course, are producers of alternating currents, but in this case the one to be run as a motor must be speeded up to synchronism, otherwise it will not run. When this synchronism ceases the motor fails to rotate. The two and three-phase machines are also reversible, as shown by the operation of rotary converters, in which that part of them in which such currents are generated or used are readily reversible. The continuous current motor possesses many features of simplicity and economy which raises it as a power producer far above the plane of all other devices with the exception of the water turbine. In this exception the efficiency, however, rarely exceeds 85 per cent., whereas in large motors it reaches a figure 10 per cent. higher or 95 per cent. The fundamental principle on which the operation of either a direct or alternating current motor rests is a corollary to the all-embracing principle of the conservation of energy. A motor is a machine in which electrical energy is transformed into mechanical energy. This is the converse of the dynamo, which is a machine in which mechanical energy is transformed into electrical energy. To transform electrical energy into mechanical energy the medium of the electro-magnet comes into play. The transformation is only accomplished, in the accepted sense of the word, in the case of motors by means of magnetism. Fundamentally all motion which results in rotation is due to the operation of the two simple laws that unlike poles attract and like poles repel. These poles are produced by electricity and by their relative positions with respect to each other, which also calls for either parallelism or a lack of parallelism in their respective fields, induces continued rotation. The development of a magnetic field within a loop of wire, when affected by a current of electricity by which it possesses all the qualifications of a magnet of equal dimensions, was first discovered and enunciated by Oersted. Thus it became subsequently possible to express magnetism qualitatively and quantitively in terms of electricity. In other words, it was found that magnetism produced by electricity could be calculated with exactitude, and the polarity as well, anticipated. Each turn of wire carrying a certain current can be regarded as a lamellar magnet possessing a certain magneto-motive force. A succession of such small magnetic pumps, as they might be called, force the magnetism through the medium whether it be iron or air. As the number of them are increased and the current in them increased their power or magneto-motive force increases in proportion. Thus, when such coils are so situated that their influence upon each other is productive of motion, it becomes evident that the power produced mechanically is in proportion to the extent of the pull resulting from such a co-operation of faces and the rapidity of motion it engenders.



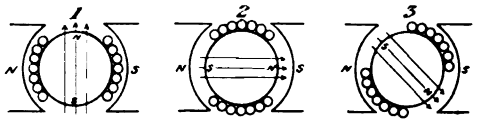
A Generator Absorbing Mechanical Power and Giving Out Electricity.



A Motor Absorbing Electricity and Giving Out Mechanical Power.

Power, then, in a motor can be measured by the speed of rotation per minute, and the degree of pull or torque accompanying it. These are things depending upon the fundamental idea of turns and current, commonly called ampere turns.

Relation of Lines of Force and Current.—The magnetic whirl surrounding a wire becomes more intense the heavier the current in the wire. These whirls spread out in ever widening circles, the center of whose vortex is the wire itself. The magnetism or lines of force, when meeting those of another field, tend to set themselves parallel, or as it would seem, tangent. When a bar of iron is inserted within a series of electro-magnetic helices its polarity becomes most pronounced and manifests itself, if movement is possible, by moving towards an opposite pole or away from a similar pole. When the magnetic field of a motor is considered, its lines of force pass between the two poles via the armature core of laminated iron placed within it. A coil of wire wound around this core can occupy a series of positions with respect to the horizontal or vertical plane. Let three positions be considered—one in the horizontal plane, one in the vertical plane, and one in a plane situated at an angle of 45 degrees. This coil as yet has exercised no influence upon the magnetic field which streams across from the north pole to the south pole of the motor. It is now to be considered as occupying the first of the positions referred to, namely, the horizontal plane.



1—Armature Coil in Horizontal Plane. 2—Armature Coil in a Vertical Plane. 3—Armature Coil in a Plane of 45 degrees.

A Coil in the Horizontal Plane.—On sending a current through the coil when in this position in the horizontal plane it acts in every respect as any other electro-magnet irrespective of the fact that it is already in a magnetic field. The turns of wire which compose it act upon the armature core of laminated iron which they embrace, and magnetize it. If a coil were in a horizontal position in space, and did not contain any iron, it would produce a comparatively weak field, whose lines of force would lie in a vertical direction. Situated as it is with a core of wrought-iron between the poles of a powerful field the same phenomenon takes place. The coil produces a vertical field, a field in fact whose lines of force are at right angles to those of the original field. It would tend to move the now vertically suspended electro-magnet so that its poles would seek the opposite poles of the surrounding field. The motion would be under the circumstances one of rotation either to the right or to the left, depending upon the relative position of the poles produced by the ampere turns of the horizontal coil and those of the field in which the armature core rests. If it is situated in an absolutely horizontal plane so that the lines of force are truly vertical and the lines of force of the field are absolutely horizontal, then a resultant field would be found. Two magnetic forces acting at right angles to each other, according to the elementary laws of mechanics, must produce a resultant force. The field would therefore be twisted and operated at an angle to its former position. The lines of force of the coil will, if permitted, set themselves parallel to those of the field, and in so doing motion would be produced.

A Coil in the Vertical Plane.—A coil so situated produces a magnetic field at right angles to itself or in a longitudinal plane. Its lines of force would therefore merge with those of the surrounding field or, if the poles were opposed to each other, reduce it to an extent dependent upon its magneto-motive force. In either case, whether the field is augmented or reduced no motion will tend to result from such a relative position, as the lines of force are now in a position of parallelism with respect to each other.

A Coil at an Angle of 45 Degrees.—It is evident from the positions of the coil in a horizontal and vertical plane that these are not the ones best suited to the production of either great pull or torque or motion, A coil at an angle of 45 degrees however, producing a magnetic field at right angles to itself, would also present poles in a position with reference to those of the field surrounding it such that motion must result. Not only will a tendency to swing around be perceived, but a strong pull will accompany it. The lines of force of the coil can set themselves parallel to those of the field only by moving the core. This will actually take place not only when coils occupy a position at 45 degrees to either the horizontal or vertical plane but when they are slightly inclined to either. Thus it becomes evident that the constant effort taking place between the lines of force due to the coils on the armature and those of the field, which are supposed to remain comparatively unchanged, can only take place when they occupy certain positions with respect to the field. Under these conditions it might be said that the circumstances present the case of one fixed magnet whose field generally retains its position and a series of movable electro-magnets whose fields are constantly assuming positions in which their lines of force lie parallel to and in the same direction as those of the field. Increasing the current under these general conditions would mean an increase in pull between the stationary magnet of the field and the movable electro-magnet caused by the various positions of the coils on the armature. The torque of the armature therefore is entirely a question of magnetic field and current in the armature, which is merely another way of saying that it is simply a question of the amount of pull resulting from a stationary and a movable magnetic field, the latter being capable of accentuation by an increase of current.

Magnetism and Mechanical Pull.—The relations existing between magnetism and mechanical pull might be construed as the relation existing between these two items and the current. In the case of an electro-magnet, to the poles of which a piece of iron or armature is to be attracted the formula is very simple. The formula gives the pull in dynes and calls for the lines of force of the poles to be given in lines of force per square centimeter as follows:

Pull in dynes = (lines of force per sq. cm.)^2 × sq. cms. ÷ 8 × 3.1416.

Or it may be written

$$P = \frac{B \times B \times A}{8\pi}$$ on the same basis

where P = pull in dynes,
B = lines per sq. cm.,
A = sq. cms.,
π = 3.1416.

To illustrate the application, take the case of a magnet having 100 sq. cms. of pole surface and the lines of force equal to 10,000 per sq. cm. The calculation will show the following result:

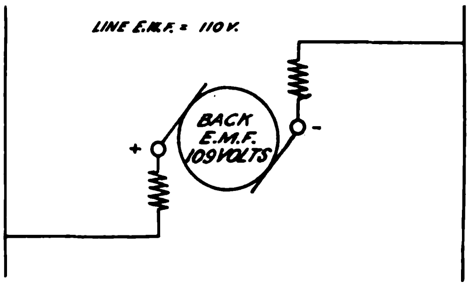
$$P = \frac{10{,}000 \times 10{,}000 \times 100}{8 \times 3.1416} =$$
386,347,721 dynes = 868 pounds.

The increasing use of electro-magnets for lifting purposes is one of the indications of the facility with which such a device can be employed in large foundries and steel works, where large masses of iron must be firmly seized and lifted.

The Back EMF. of a Motor.—The adjustment which takes place between the load of a motor and the power it consumes is brought about by means of the back electro-motive force. This EMF. is developed within the armature for the same reason that any other EMF. is generated in conductors cutting a magnetic field. The armature of the motor, though caused to rotate by the reaction between the field of the magnets and the field of the conductors, nevertheless presents the case of free conductors rotating in such a manner that the lines of force they meet are cut and necessarily produce EMF. It is a simple matter to calculate this back EMF. by multiplying the revolutions per second by the number of conductors by the lines of force of the field and dividing by 100,000,000. The conditions which exist within the armature of a motor when in action therefore are as follows: Current is allowed to enter the motor, energizing the field magnets, and passing through the armature in a limited manner. The rotation which then ensues is the means of generating an EMF. within the armature conductors. There is therefore two electro-motive forces in action within the armature; one of which tends to send a current through it, and the other, which opposes or counteracts the effect of the entering EMF. If the EMF. *generated* within the armature conductors is called the back or counter electro-motive force, the EMF. applied to the motor can be called the line or impressed EMF.

How the Back EMF. Varies.—A study of EMF. with respect to its generation by means of motion, lines of force and conductors, shows how variations in the amount of EMF. developed may be brought about. Any increase in the number of conductors on the armature of a motor will give rise to a higher back EMF. Any change in the speed of a motor will give rise proportionately to an equivalent change in the back EMF. of a motor. And finally any increase or decrease in the strength of the magnetic field will be the means of causing a change in the back EMF. These influences are thus referred to because the regulation and operation of motors is dependent upon these principles not only in theory but in actual practice.

Load and Back EMF.—When an impressed EMF. acts upon the field and armature windings of a motor, current is sent through the first, producing a field of given strength, and through the second in developing rotation and its concomitant power. The remarkable fact about the work a motor is doing and its back EMF. is this: When the motor is running free, or "idle" as it is called, the motor is developing the highest back EMF., and in consequence the impressed EMF. is only able to send a small current through the armature. The effective EMF. in this case is the *difference* between the impressed EMF. and the back EMF. This effective EMF. will send a current through the armature which is governed by the resistance of the same. For instance, if the armature has a resistance of .01 of an ohm, the impressed EMF. equals 110 volts and the back EMF. equals 109.5 or 109.75 volts. The difference between 110 and 109.5 volts is .5 volt, which with a resistance of .01 of an ohm would mean a current of $.5 \div .01 = 50$ amperes. The difference between 110 and 109.75 volts is .25 volt and this would send a current through the armature of $.25 \div .01 = 25$ amperes. Therefore a very low resistance armature needs but a very small effective pressure to send a heavy current through. The frequent changes of load to which a motor is exposed will when taking place vary the speed slightly. If the load is reduced the speed will increase, and if the load is increased the speed will diminish. It is thus evident that the back EMF. will vary accordingly, and that less or more current will pass through the armature. The back EMF. therefore acts as a natural automatic valve which opens wider when the load on the motor is increased and therefore more current is required, and which, so to speak, closes when the load on the motor is diminished and less current is required.



Armature Receiving Current through Difference of Line and Back EMF.

* * *

Electricity in Mills and Mines.

Electricity is beginning to play a prominent part in the operation of both mills and mines in Colorado. In the mines the incandescent lamp has largely taken the place of the miner's candle, trolley cars have replaced the car propelled by mule power and the old time steel and single jack is displaced by the electric drill. In many instances hoists are operated by electricity instead of by steam. Electric pumps for several mines in that State are the latest things by which electricity can be utilized in the mining of coal. One company states that the cost of making the change will reach several hundred thousand dollars, but this will soon be saved by the reduced cost of operation.

* * *

TWO MOTOR VERSUS FOUR MOTOR EQUIPMENTS.

In railway work a variety of problems arise, connected with the growth of the city and the density of the population. The development of a street railway is governed by these and other conditions such as the number of grades met and the degree of acceleration required. In a paper read before the American Institute of Electrical Engineers February 24, 1905, Mr. N. McD. Crawford discussed "Two Motor vs. Four Motor Equipments" for the purpose of ascertaining the relative advantages and disadvantages in the way of commercial efficiency associated with trials of this description. Four cars were selected bearing the following numbers: No. 169, 138, 101 and 480. In order to present the data relative to these cars in the most convenient form it is tabulated as follows:

No. car.	Body.	Trucks.	Cost.	Weight. Tons.	Horse-power.	Gear Ratio.	Commercial efficiency.
169	20 feet.	Single.	$2,710	9.075	Two 25 motors	1 to 4.87	17 %
138	26 feet.	Two.	3,275	12.425	Two 35 motors	1 to 2.82	13.11 "
101	26 feet.	Two.	4,360	14.675	Four 35 motors	1 to 2.82	12.53 "
480	29 feet.	Two.	5,040	20.680	Four 40 motors	1 to 3.67	10.66 "

The test with two 2 motor and two 4 motor cars and their equipments was conducted fairly and equally. The distance covered by every car was the same, namely, 136.5 miles each day; and the rate of speed represented on an average 8.45 miles per hour. A careful record was kept of the changes in power by means of a wattmeter in each car; and the variations in current and pressure were noted also by means of a voltmeter and ammeter installed in each car. For the benefit of the reader it may be stated that two important records were also taken, during periods of acceleration, and when grades were being climbed. The idea of acceleration is one of vast importance in street railway work and may be best understood by the explanation that if one car can accelerate quicker than another, it can leave a given spot in a shorter time with an equal weight of passengers. Therefore the figures that were taken in the course of this test, which indicated the power consumption during the acceleration, and the hill or grade climbing, represent a basis of comparison of the greatest interest. The cars with their equipments subjected to the run of miles, and rate of speed noted, gave a series of efficiencies which, in connection with the weight of each car in tons, the seating capacity, cost per seat and cost per ton, constitute an excellent table of reference. The highest commercial efficiency was obtained from No. 169, whose seating capacity was 26 representing a car costing $2,710, and yielding an efficiency of 17 per cent. This high efficiency, in comparison with that of the other three cars, which were only 13.11, 12.53 and 10.66 per cent. respectively, was the result of the particular circumstances under which the test was conducted. Car No. 480 had the lowest efficiency, which in connection with the other cars and their equipments brings out a point of particular interest. In order to appreciate it, the list of motor equipments must be scanned, and it will be noted at once, as the eye travels down the list, that the weight and power of the motors increases in each car.

That is to say, cars No. 169, 138, 101 and 480 represent total weights of 9.075, 12.425, 14.675 and 20.680 tons respectively.

But it will also appear that the efficiences of these cars under test resulted in the figures of 17, 13.11, 12.53 and 10.66 per cent. *In other words, the author demonstrates clearly that these cars of increasing weights, powers and cost represented under the conditions noted, decreasing efficiences.*

The moral is therefore obvious, that "light two motor, single truck equipments were *best* for service under the conditions selected."

This being the case, the heaviest and most powerfully equipped car which cost $5,040 (in comparison with the first, costing the least, $2,710) would prove more efficient on a road where longer trips are made, where there are heavier grades, where greater speed is necessary, where more rapid acceleration is required and where there is finally a denser population.

The most careful study of these circumstances is the determining factor in the selection of car equipments, so that the question of two motor versus four motor cars is to all intents and purposes a question relating to the study of a variety of conditions.

As the author states, "The operating manager is looking not only for an equipment that will fulfill all the requirements of any particular service with the least cost for repairs, and the minimum demand on the power station, but also for one that will combine these advantages at the greatest speed with safety to the public, and the distance to be traveled per trip will allow."

The author recommends a careful consideration of the following items in the determination of the best cars and motors for a certain kind of service:

First—The density of population.

Second—The number of trucks and motors.

Third—The speed in miles per hour.

Fourth—The gear ratio.

The argument he advances is that the *density of the population* must govern the size and seating capacity of the car; also the rate at which stoppages occur, and thus the degree of acceleration required. The speed in miles per hour is necessarily dependent upon this fact and unquestionably the frequency of service as well.

The number of trucks and motors will govern the size and weight of the cars. This is a measure of the tractive effort or draw bar pull, and this again involves the question of acceleration.

The speed per hour is the third point to be considered, particularly with reference to the number of cars in service. An increase in this direction means more power, more of what is called "platform labor" in the car, and, financially speaking, more interest charges to pay because of the increased line expense and power plant equipment.

Not the least important is the *gear ratio* whose influence upon the horse power of the motors, the acceleration, stops per mile, heating, repairs, and finally, station and line requirements, is self-evident.

The last statement of the author with reference to this matter is very interesting as well as concise and simple. He says:

"Too much care cannot be exercised in determining the gear ratio for given service; for there can be no doubt that in many cases lack of power station equipment and excessive motor repairs can be traced to the use of wrong gear ratio. In the first place, cars should be selected of ample capacity for the service requirements, and then motors should be selected with a rating only slightly greater than the service requires, and with a gear ratio so designed that the schedule may be made without resorting to rapid acceleration on starting, and, as a consequence, running the motors on low-efficiency points in order to kill time."

SERIES ALTERNATING ARC LIGHTING.*

BY E. P. WARNER.

During the past three or four years the very extensive introduction of series alternating arc lighting in the United States and Canada for the illumination of streets and public places has called for studious consideration of conditions and results. Valuable experience has been gained and it is gratifying to find that substantial advance has been made in both the reliability and cost of operation. Looking back at the old direct current arc generators of a few years ago, with their very limited capacity and high cost for maintenance, and comparing them with the large direct connected generators of the present day with their high efficiency, practically unlimited capacity, compactness and simplicity, the station engineer, and indeed all financially interested, cannot fail to appreciate that in the series alternating system of arc lighting we have the practical solution of a number of problems. First to build our generators to any desired capacity, second to greatly reduce the floor space required, and third to cut down cost for attendance and repairs.

REQUIREMENTS OF A MODERN SYSTEM.

The conditions which confront the engineers and others, responsible for the welfare of large municipalities, are such as to call for most earnest and careful study, and not the least exacting to meet are those pertaining to the lighting. What system shall we install and how shall we install it, are the questions for which answers must be found. The engineer or station superintendent is called on to consider the different systems and plans of installation from the standpoints of reliability of operation, cost to install and cost to operate. In doing this he is sometimes hampered by local conditions, but as a rule is free to carry out his own ideas and make his own selection of a system.

In many of our larger cities, the lighting systems at present in use, and a number of which have been installed within the last ten years, are so far from filling the demands of economy and certainty of operation that it will not be long before the increased service and reduced cost demanded will bring about their replacement by systems more fully filling all requirements.

In the series alternating arc lighting system of to-day we have a most practical, I may say beautiful, means by which the necessary electrical energy can be supplied to the different sections of a large city. Instead of a large number of small lighting stations scattered about the city, with their attendant nuisance of smoke, noise and dirt, their high cost to maintain and operate and many other objectionable features, we can have large stations located at a considerable distance from the city where land would be comparatively cheap, also condense water and fuel. From this station supply mains at high pressure can be run to any desired number of distributing stations equipped with transformers and regulators. Such a station would be practically noiseless, smokeless and in fact free from nearly all the objections that can be made to the present direct current lighting station. Again, the cost of installation can be brought below that of the small separate stations and the cost to operate very considerably reduced. There is suggested by this system a practical solution of the problem of the smoke nuisance. We may some day have large stations located some distance from the city equipped with smokeless furnaces, from which the city will receive its supply of light, heat and power—then good-bye smoke.

(To be continued.)

Electric Storage Battery Secures New York Central Contract.

The Electric Storage Battery Company of Philadelphia, has been awarded a contract by the New York Central & Hudson River Railroad Company aggregating $900,000, for the equipment of several power houses with electric storage batteries for use in operating the New York Central's trains in and out of New York. Power houses will be built at intervals along the railroad for a distance of 60 miles out of New York, and locomotives will be equipped with electricity to be used as far as Peekskill.

Nine Reasons.

There are said to be nine excellent reasons why the Crosby spring seat valve, manufactured by the Crosby Steam Gauge & Valve Company., Boston, Mass., is the best, because, 1, of its strength, quality and durability; 2, disk seats and valve seats are made of the very best alloy, and from their peculiar construction resist any cutting from the flow of steam; 3, all working parts renewable without removal of valve from the piping; 4, all parts interchangeable; 5, they have a full opening through them; 6, both brass and iron valves are easily and quickly repacked when in use; 7, made only by workmen of the highest skill with special tools; 8, only best materials used; 9, all valves when completed are tested under more than 400 pounds hydraulic pressure to determine the tightness of the seat and strength of the metal. They are guaranteed not to leak at high pressures.

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* Paper read at the 13th annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 18-20, 1905.

Hunt "Industrial" Railways.

Few realize the saving made by the use of a narrow-gauge track and suitable cars in handling raw and finished materials. The C. W. Hunt Company of West New Brighton, Staten Island, can furnish figures in this connection that are surprising.

A manufacturer who needs a railway for handling material is immediately confronted by such questions as:

What gauge is best for that purpose? What radius curves should be used? How heavy should the rail be? What style of cars will be best? What kind of cross-ties should be used? How shall the switches and crossings be made? Can turntables be avoided? Can a locomotive be used?

And so on, until it looks as though he would have to abandon his regular business to decide these details.

The Hunt system of railways sold under the trade name "Industrial" answers these questions, and furnishes without trouble, delay or expense, the results arrived at by those who have given the subject careful consideration for many years, both as builders and users of this class of machinery.

The Unit Accumulator.

The National Battery Company of Buffalo, N. Y., is prepared to make new installations complete of electrical machinery, or to make renewals of batteries already installed. The unit accumulator manufactured by this well known concern has been especially designed for high charge and discharge rates, long life and high efficiency.

The unit accumulator positive (Plante) plate is constructed in such a manner that the units, or active portions, are so firmly attached to the rigid frame that they are a part of it, and the full contact between the two exists during the entire life of the plate.

The two sides of the unit are uniform, and the developed surface is sufficient to give high efficiency. In addition to this its mechanical structure is strong, holding the active material closely to it, and allowing free release of the gases.

The National Battery Company has adopted the pasted type (Faure) of negative, and has developed a grid in which the natural molecular shrinkage of the active material has been provided for and taken advantage of, so that the contact is maintained as the shrinkage progresses, owing to the fact that the active material inclosed in the contact portions is drawn more tightly around the grid projections or pins. A negative plate which loses its contact by shrinkage will cease to give its full capacity as this physical change takes place.

Effect of Lubricating Graphite on Engine Cylinders and Bearings.

Satisfactory lubrication depends as much upon the condition of the surfaces as upon the quality of the lubricant itself, and the smoother the bearing surface can be made, the easier it is to lubricate. This point is strongly emphasized when Dixon's Pure Flake Graphite is used in lubrication. When introduced between friction surfaces it soon rubs into the metal, filling every pore and crack and irregularity in the surfaces, coating them with a veneer of great firmness and endurance and of exceeding smoothness.

Cylinders in which graphite has been used take on a wonderful mirror-like polish and valves work quietly and without straining or cutting. Time and again overloaded engines have been able to do all the heavy work demanded of them where graphite has been used in their lubrication when they would otherwise have been stalled. Bearings on which graphite is used never overheat, and overheated bearings are rapidly cooled, and it is a fact proved beyond any question that "seizing" and cutting of friction surfaces cannot take place in the presence of graphite. Therefore in those engine rooms where it is regularly used there will never be any of those costly and perhaps disastrous results of overheated bearings.

Thinner, cheaper oils will suffice for work that formerly required the use of expensive heavy-bodied lubricants, and friction will be lowered with corresponding benefit to the coal pile. Shut-downs and repairs will be fewer and much trouble saved. Graphite lubrication has long since passed the experimental stage and thousands of men are using it regularly with most satisfactory and paying results.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED FEB. 21, 1905.

Electric Railways and Appliances.

782,884. Electric Signaling Apparatus for Railways. Thomas H. Traylor, Denver, Col. Filed Nov. 9, 1904.

782,936. Insulated Step-Joint. George A. Weber, New York City, assignor to the Weber Railway Joint Manufacturing Company, same place. Filed March 13, 1903.

783,027-028. Electric Railway. Joseph Dela Mar, New York City, assignor of one-half to Mathias A. Lazareff, same place. Filed March 8 and June 9, 1904.

783,034. Traction Wheel. Fred A. Gerling, Portland, Ore. Filed June 7, 1904.

783,080. Electric Coupling. Edward F. Ruth, Baltimore, Md., assignor of one-third to Clement H. Warner, same place. Filed June 2, 1903.

783,228. Trolley. Charles J. Sosenheimer, Allegheny, Pa., assignor of one-fourth to William S. X. Taylor, same place. Filed Aug. 11, 1904.

Electrical Machinery and Apparatus.

782,826. Alternating-Current Rectifier. William B. Churcher, Cincinnati, O., assignor to Kenyon Dunham, same place. Filed Sept. 3, 1904.

782,863. Alternating-Current Motor. Robert Lundell, New York City. Filed Jan 11, 1904.

782,887. Rheostat. Hermon L. Van Valkenburg, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed June 6, 1904.

783,001. Reciprocating Electric Engine. Bruno O. Wagner, El Paso, Tex. Filed Sept. 22, 1904.

783,102. Reciprocating Electric Motor. Louis Casper, Chicago, Ill. Filed March 23, 1903.

783,124. Motor-Control System. Maurice Milch, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 10, 1904.

783,197. Machine for Insulating Electric Conductors. Charles H. Hawkins, Long Island City, N. Y. Filed Aug. 2, 1904.

783,397. Winding for Dynamo-Electric Machines. Bernard A. Behrend, Norwood, O., and Edwin C. Wright, Newport, Ky., assignors, by mesne assignments, to the Bullock Electric Company. Filed Nov. 6, 1903.

783,398. Dynamo-Electric Machine. Bernard A. Behrend, Norwood, O., assignor, by mesne assignments, to the Bullock Electric Company. Filed Nov. 24, 1903.

Telephones and Telephone Apparatus.

782,828. Measured-Service Telephone-Exchange System. Henry M. Crane, New York City, assignor to the Western Electric Company. Filed Aug. 31, 1903.

782,937-783,340. Telephone-Exchange System. Harry G Webster, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed Dec. 3 and 5, 1903.

782,944. Multiparty-Line Locking-Out System. Garrison Babcock, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed Nov. 19, 1903.

783,231. Hygienic Telephone-Receiver. Louis Steinberger, New York City. Filed Aug. 15, 1904.

783,283. Telephone-Receiver. William Kaisling, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed Feb. 19, 1903.

783,302. Automatic Telephone-Exchange. Nils E. Norstrom, Junction City, Kan., assignor to John Anderson, Salina, and M. E. Richardson, Sterling, Kan. Filed April 10, 1900.

Miscellaneous.

782,816. Electric Fan. Adolph F. Becker, Elizabeth, N. J., assignor to the Diehl Manufacturing Company. Filed April 12, 1904.

782,849. Electric Time-Alarm. Frank Hermance, Union Hill, N. J. Filed July 30, 1904.

782,873. Electric Igniting Plug. George H. Oakes, Arlington Heights, Mass. Filed Dec. 8, 1903.

782,894. Electrolytic Process of Reducing Metallic Sulfids. Charles E. Baker and Arthur W. Burwell Cleveland, O. Filed July 1, 1904.

782,917. Electric Furnace. John M. Morehead, Chicago, Ill., assignor to the Union Carbide Company, same place. Filed Oct. 19, 1903.

783,057. Electric Air-Diffusing Device. Timothy Mahoney, San Francisco, Cal. Filed Nov. 26, 1904.

783,061. Electric-Terminal Clip. David B. Mills, East Orange, N. J. Filed May 3, 1904.

783,141. Thermo-Electric Signal. Martin J. Schick, Bellaire, O. Filed April 21, 1904.

783.174. System of Electrical Control. Eugene R. Carichoff, East Orange, N. J., assignor to the Sprague Electric Company. Filed Aug. 9, 1898.

783,229-230. Locking-Insulator and Insulator-Support. Louis Steinberger, New York City. Filed March 19 and May 11, 1903.

THE TELEPHONE WORLD.

Bell Telephone Company to Issue Bonds.

It has been definitely decided to finance this year's requirements of the American Telephone Company by an issue of $25,000,000 bonds. The bonds will carry 4 per cent. interest.

It is understood that bids will be received from to-day (March 1) and that payments to the American Telephone Company will be at the rate of about $2,000,000 a month.

The bonds will be collateral trust bonds, secured by the deposit of subsidiary company stocks, and will be similar in character to the present outstanding 4s. The present outstanding bonds amount to $28,000,000 and are due in 1929.

Active Campaign for Independent Franchise.

The promoters of the Independent Telephone Company in Council Bluffs, Ia., have begun an active campaign for a franchise and have planned to do considerable canvassing between now and the day of the special election, which is set for March 27.

Attorney F. W. Miller, who has been selected by his fellow promoters to organize the campaign, states that the company does not intend to rely solely on the passage of the franchise ordinance by the mayor's vote, but will shortly file with the mayor the petitions bearing the requisite number of signers, asking him to call a special election. The date named in the petitions is March 27, the same as in the resolution adopted by the city council authorizing the mayor to call such election. The call to be issued by the mayor, Mr. Miller claims, has been prepared, and all that remains is for Mayor Macrae to attach his official signature to it and then for it to be published according to law. The franchise ordinance has to be published with the call and also has to be printed on the ballots. A sum to cover the expense of the special election will be furnished by the Independent promoters.

The Stromberg-Carlson Telephone Manufacturing Company of Rochester, N. Y., reports that it is just completing one of the finest toll boards that it has ever turned out, for the United States Telephone Company of Toledo, O. The board consists of five sections of three operators' positions each, and is equipped with the most modern apparatus.

The Citizens' Telephone Company of Columbus, O., held a stockholders' meeting a few days ago and C. C. Griswold was chosen as a director in place of H. D. Critchfield, who retired from the board. The old officers were re-elected. Frank L. Beam is the general manager of the company.

The Edgerton (Wis) Telephone Company has secured the business of the Bell long-distance line into that city. The wires of the latter company will be connected with the local company's switchboard, and the Bell office discontinued.

The city council of Rushville, Ind., refused a franchise to the Spiceland Co-operative Telephone Company on the ground that the Bell Telephone Company was behind the application.

Independents to Hold District Meetings.

The Ohio Independent Telephone Association, organized last summer at Columbus by all the Independent exchanges in the State, has been subsequently divided into districts, and each district, which is presided over by a vice-president of the parent body, is holding meetings to further the interests of the Independent exchanges, and incidentally present a solid front to the Bell.

The Eighth district of the Ohio Independent Telephone Association, comprising the counties of Williams, Fulton, Lucas, Ottawa, Sandusky, Seneca, Wood, Henry and Defiance, held a recent meeting at which R. E. Hamblin of the Toledo Home Telephone Company, who is a vice-president of the State organization, presided. Representatatives were present from nearly all of the 37 exchanges in the district.

The Whitthorne Telephone Company is one of the latest Independent companies to be established in Carroll County, Tenn., and the new company is in a most prosperous condition. Its lines are now connected with the Mixie Telephone Company, the Beaver Creek Company and the Dixie Company, and its system is being extended to Huntingdon. J. T. Lewelling is president of the Whitthorne Company, and W. E. Robinson is secretary and treasurer. Carroll County is now a perfect network of Independent telephone companies, there being no less than 15 small companies in operation. Several of these lines run into Huntingdon and have good patronage from physicians and others.

George W. Manble, a stockholder in the local telephone company at Fort Scott, Kan., has brought suit in the district court to enjoin the company's officers from transferring its assets to the Bell Telephone Company, which lately bought all but a few shares of the stock. The Bell Company was preparing to consolidate the two concerns. The court is asked to appoint a receiver for the local company.

A long clash between the United Telephone Company and the citizens of Pottsville, Pa., because the corporation raised its rates, was settled last week by the borough council granting a new franchise. Hostilities had advanced to such a stage that the borough authorities went to court with a suit in equity, and the company was directed to remove its poles and wires from the town.

At the annual meeting of the stockholders of the Rural Telephone Company of Hennepin County, Minn., held at Osseo, the company was reported to have 102 patrons, 90 miles of wire and six toll lines. The exchange is in Osseo, and lines run into Corcoran, Hassan, Maple Grove, Brooklyn, Champlin, Rogers and St. Michaels.

At the annual meeting of the stockholders of the New York & New Jersey Telephone Company, held in Brooklyn Friday, the retiring board of directors was re-elected.

The Washtenaw Home Telephone Company of Ann Arbor, Mich., has filed articles of incorporation with a capital stock of $300,000.

Telephone Trust Hearing at Albany.

After a conference between the chairmen of the finance committee and the Assembly committee on ways and means it was decided to hold the first public hearing on the joint resolution for a legislative investigation of the telephone trust on Tuesday, March 7, at 2 P. M.

A number of the farmers of McPherson and Edmunds Counties, S. D., recently organized a telephone company under the name of the Edmunds County Mutual Telephone Company. A. Hoffman of McPherson County was elected president, and F. Blakeman of Edmunds County treasurer. The company controls several rural lines which already are built and will extend the lines during the coming spring and summer.

Residents of Eagleport, O., have become greatly interested in the proposition to build a telephone line from there to Gaysport. A big mass meeting was lately held in the town hall for the purpose of organizing a company to carry out this project. Much enthusiasm was shown at the meeting and it is believed that the enterprise will be a success. It is expected to begin work at once on the new line and it is believed that it will be completed within about six weeks.

One hundred farmers in the lower part of Schuylkill County, Pa., are organizing clubs for the purpose of building Independent telephone lines through their lands to connect with the big trunk lines. Timber is now being cut for the poles.

The Glenville-Inland Telephone Company, operating between Glenville and Inland, Neb., will soon put up more wires. It has lately installed two new switchboards for use in the above towns and will accommodate about 40 subscribers.

The telephone lines erected on the Reading Company's road west of Harrisburg, Pa., to be used in connection with the train service, have been completed and put in operation.

The Glen Telephone Company lately opened its new exchange at Fonda, N. Y.

Telephone Incorporations.

The New York Independent Telephone Company, Albany, N. Y.—to operate in New York City to Boston, Albany, Jersey City, Philadelphia, and other places in the States of New York, Massachusetts, Rhode Island, Connecticut, New Jersey and Pennsylvania, Capital stock, $50,000. Directors: O. S. Lee, Jr., J. M. Woods and B. S. Mantz, New York.

The Healdsburg and Alexander Valley Telephone Company, Healdsburg, Cal. Capital stock, $5,000. Directors and officers: C. F. Matthews, president; W. F. Young, secretary; Thomas Alexander, William McCutcheon and C. C. Hall.

The New Citizens' Telephone Company, Batavia, O. Capital stock, $150,000. Incorporators: B. W. Gilfillan, W. H. Baum, W. F. Fee J. C. Wood, W. G. Jones and G. H. Eveland.

The Worcester Telephone Company, Worcester, N. Y. Capital stock, $1,000. Incorporators: James Nelson, Guy Coats and S. Shafer, all of Worcester.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Albany, N. Y.—The board of directors of the Albany Electric Illuminating Company decided that on and after to-day (March 1) the price of lighting current shall be reduced from 20 cents to 15 cents per kilowatt hour.

Albion, N. Y.—It is reported that a combination of capitalists is being formed to combine the electric light and power plants in this place, Holley, Brockport, Middleport, Lockport and Batavia in one big corporation. J. H. Rollins, superintendent of the plant here, is to be general superintendent, and at present the promoters are connected with the Albion Power Company. It is thought the power will come from Niagara Falls.

Bluffs, Ill.—Fred Brockhouse has secured a franchise for the erection of an electric light plant.

Buffalo, N. Y.—An electric light plant in the new 65th Regiment Armory, to cost $89,000, is proposed. Plans will be prepared by George J. Metzger, architect.

Cairo, Ill.—The city council has set aside $5,000 for an electric light plant.

Colonial Beach, Va.—The city council has granted a 20-year franchise to the Colonial Beach Electric Light & Power Company for an electric light plant and telephone system. Warren S. P. Combs is president and general manager of the company.

Danville, Ky.—The National Construction Company of St. Louis, Mo., has prepared plans for the construction of the new electric light plant to be built here. E. R Vincent, consulting engineer for the town, may be addressed.

Dixon, Ill.—Plans are being prepared by the Lee County Lighting Company for the extensive improvements to be made to its power plant.

Fairbury, Ill.—The Fairbury Electric Light & Power Company has increased its capital from $12,000 to $30,000.

Lena, Ill.—The village board has granted a franchise to Benfer Brothers of Winslow to erect and operate an electric light plant here, and contracted for $1,200 worth of street lamps for a period of ten years.

Litchfield, Ill.—A 75-year franchise has been granted to the Litchfield Electric Light & Gas Company.

Manassas, Va.—The Manassas Illuminating Company, with a capital of $5,000, has been incorporated by W. N. Lipscomb, R. S. Hynson and others to furnish light by electricity for manufacturing plants, etc.

McKinney, Tex.—Jesse Shain, J. D. Bass. and Giles L. McKinney compose the committee which has been formed to install an electric light plant.

Miami, Fla.—W. W. Prout has applied for a franchise to construct and operate an electric lighting and heating plant here.

Millville, Cal.—A proposition to have electric lights in this place is now being considered by several of the local business men.

Oskaloosa, Ia.—The electric light and telephone wires were considerably damaged by a recent $150,000 fire.

Paris, Ill.—The City Gas & Electric Company has increased its capital to $60,000. Improvements are contemplated.

Pass Christian, Miss.—The town council has invited bids for furnishing this place with electric lights.

Sebree, Ky.—It is reported that J. B. Ramsey has secured a franchise to construct and operate an electric light plant.

South Bend, Wash.—The city council has granted to J. M. Etnier a 45-year franchise for furnishing electric power and lights.

Walker, Minn.—The village council has decided to place before the citizens at the general election in March a bonding proposition for the purpose of buying and installing a more powerful electric light plant than that now possessed and which, owing to its inadequacy, has been out of use for some time. It is now proposed to issue bonds to the amount of $4,000, which will furnish a lighting plant for some years to come.

Washington, Pa.—The West End Electric Light, Heat & Power Company of this city has been incorporated with a capital of $25,000 by John Slater, John W. Hallam, Owen Murphy and others.

Wiggins, Miss.—The Wiggins Electric Light Company has been formed with a capital stock of $10,000.

STREET RAILWAYS.

Boston, Mass.—A recent announcement is that an electric railway between this city and Providence, to be operated over a private right of way and at high speed, is to be built. It is the intention of the promoters to use the elevated structure from Forest Hills into this city. It is asserted that stock has been subscribed, surveys made and options on some private land taken and that four groups of promoters have pooled their interests in the plan.

Cleveland, O.—The Electric Railroad Improvement Company has increased its capital from $20,000 to $50,000.

Coshocton, O.—The Zanesville, Coshocton & New Philadelphia Traction Company has been formed to build an electric railway from Zanesville to New Philadelphia. John W. Cassingham, George C. Hay and others are interested. Its capital stock is $10,000.

Ephrata, Pa.—New York and Philadelphia capitalists are said to be interested in a plan to build a trolley line from Norristown to Harrisburg, the first section to be built extending from Norristown to this place, a distance of about 55 miles. Surveyors have been engaged, and they will begin work as soon as the weather will permit. The road when completed would have a total length of 90 miles, and would be the largest continuous trolley line in the country.

Evansville, Ind.—The Evansville & Eastern Traction Company will construct a line from this city to Rockport.

Lebanon, O.—The Miami Transit, Light & Power Company has been incorporated, with a capital of $600,000, to bnild an electric road from here to Xenia. The incorporators are F. C. Richards, M. D. Burke and others.

Marengo, Ill.—The citizens are making an extra effort to obtain an electric road for this place.

Medford, N. J.—There is a rumor here to the effect that William J. Thompson of Gloucester, who owns the new hotel at Harvey Cedars, Ocean County, has under consideration the construction of a trolley line from Gloucester to Manahawkin, through the Burlington County town, for the purpose of booming the seaside resort that he desires to make popular at all seasons of the year.

Morris, Ill.—The Northwestern Traction Company will erect an electric line from here to Yorkville.

Saugatuck, Mich.—The village board will grant a franchise to an electric line.

Valley City, N. D.—E. R. Bradley has asked for a franchise to construct a trolley line in this city.

Washington, Ia.—This city has voted to grant a franchise to the Iowa City, Kalona & Washington Electric Interurban Railway Company.

Wheatland, N. D.—An electric line will be erected between Fargo and this place.

POWER PLANTS.

Dayton, O.—The Dayton Malleable Iron Works will expend $40,000 in improvements. A new power plant is to be built.

Keokuk, Ia.—A project is on foot to dam the Mississippi River, between this city and Hamilton, Ill., for power purposes. If the project for which this dam will form the basis is carried out, it will result in the construction of the largest power plant in the world. The largest plant at Niagara will develop 50,000 hp. The plant under contemplation here is planned to develop not less than 60,000 hp., which will be available for the surrounding towns for a radius of 60 miles. It will call for an investment of not less than $6,000,000 and will be built entirely without cost to the Government.

Pittston, Pa.—The Erie Coal Company will build a large electric power plant on the outskirts of this city for the purpose of operating its collieries with electricity.

Port Clinton, O.—Negotiations have been closed for the electrical equipment for the new Toledo, Port Clinton and Lakeside permanent power plant to be located here or at Oak Harbor.

BIDS WANTED.

Clarinda, Ia.—The Lee Electric Light Company is in the market for the following equipment: One 100 hp. high pressure return tubular boiler, one simple or compound Corliss engine for direct connection to a two-phase alternator and one 100 or 150 kw. two-phase, 60-cycle, 2,000-volt alternator.

Graham, N. C.—Bids will be received for the construction of waterworks and electric light and ice plant for this city. H. A. Pressy, engineer, 1416 F street, N.E., Washington, D. C.

Jacksonville, Fla.—The Florida Dental Supply Company of this city wants prices from dealers on small motors and dynamos.

Muncy, Pa.—Sprout, Waldron & Co. of this place want a new or second-hand 2 hp. electric motor in good condition.

Richmond, Va.—The Cardwell Machine Company, 1900 East Carry street, this city, is in the market for 15 to 25 and 30 hp. vertical engines and boilers, mounted on one base; engines to be plain slide valve of suitable size cylinders to give above running powers running at norma speed.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15¼@15⅜c.; casting, 14⅞@15c.

Earnings of the Philadelphia Electric for the month of February are reported at $50,000 more than for the same month in 1904.

According to Chicago dispatches, the North Shore Electric Company has increased its capital stock from $1,250,000 to $2,000,000.

The Mexican Telephone & Telegraph Company has filed a certificate of organization at Portland, Me., to conduct electrical plants; capital $10,000.

The Detroit United Railway Company has applied to the New York Stock Exchange to list $4,257,000 first consolidated mortgage 2½ per cent. gold bonds of 1932.

The Milwaukee Heat, Light & Traction Company, a subsidiary of the North American Company, has increased its capital stock from $500,000 to $1,000,000.

The Massachusetts Railroad Commissioners have set March 2 as the time for hearing the petition of the Boston Elevated Railway Company to issue $7,500,000 bonds.

The franchise of the Vandergrift Construction Company of Philadelphia to build a $3,000,000 electric road from San Juan to Ponce, Porto Rico, has been revoked by the executive council.

Based on the present volume of output and the known factory cost, it is estimated by General Electric people that the net profits of the company are running at about $1,000,000 a month.

President Winter of the Brooklyn Rapid Transit Company has announced that $2,500,000 would be spent at once by that corporation to provide additional equipment for elevated and surface lines.

It is understood that plans have been made for refinancing the United Electric Railway Company of Baltimore and that an assessment will be made on the common stock of the company.

The Montgomery (Ala.) Traction Company has been placed in the hands of a receiver on petition of the North American Traction Company of New York, in default of the payment of the interest on $400,000.

Plans for the erection of a large new power house for the Chicago City Railway Company, to cost $5,000,000 to $6,000,000, are being prepared. Electricity will be supplied from this power house for all lines of the system, according to present plans.

The Missouri Central Railroad Company, capital $4,000,000, is soon to increase its capital to $12,000,000. St Louis financiers are promoting it for the construction of an electric railroad from St. Louis to Kansas City. An air line is promised within two years.

It is announced that the controlling interest of the International Traction Company of Buffalo, N. Y., which was held by Cuyler, Morgan & Co. and J. P. Morgan & Co., has been sold to Henry J. Pierce and his associates of Buffalo. It is understood that Mr. Pierce, who is president of the Buffalo Chamber of Commerce, will succeed W. Caryl Ely as president of the company. The company has a capital of $15,000,000, of which $5,000,000 is 4 per cent. cumulative preferred and $10,000,000 common stock.

ELEOTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Feb. 25
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	173
Metropolitan Street Railway	120⅛
Metropolitan Securities	80¾
Ninth Avenue	197
Third Avenue	132¾
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	63⅜
Interborough Rapid Transit	205
New Orleans Railway	4⅛
Public Service Corporation (New Jersey)	141
Philadelphia.	
Consolidated Traction of New Jersey	82⅛
Philadelphia Traction	101
Union Traction	58⅞
Boston.	
Boston Elevated	156
Massachusetts Electric Companies, com	15¼
do. do. do. pref.	57
West End Street, com	98⅛
do. do. do. pref.	115⅛
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	11¼
do. do. pref.	51
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	17¾
do. pref.	66
Electric Boat, com	41
do. do. pref.	82
Electric Lead Reduction	⅛
Electric Vehicle, com	14⅛
do. do. pref.	25
Westinghouse, com	180⅛
do. pref.	192
General Electric	187
Boston.	
Edison Electric Illuminating	252
General Electric	187
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	42¾
do. do. pref.	112¾
Philadelphia.	
Electric Company of America	12⅛
Electric Storage Battery, com	89¼
do. do. do. pref.	89¼
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	146
Western Telephone Company	20⅛
New England Telephone Company	136
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210¼
Mexican Telephone Company	1⅛
New York & New Jersey Telephone Company	172⅛
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93⅜
Chicago Telephone Company	142
MISCELLANEOUS STOCKS.	
Otis Elevator Company	49⅞
Consolidated Car Heating	64
Standard Underground Cable	200

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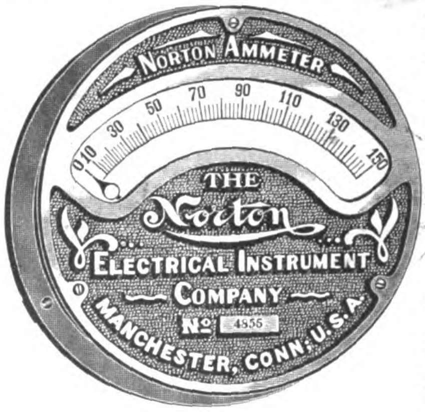
0 to 750 volts.
0 to 10 amperes.
0 to 1500 amperes.


NORTON AMMETER
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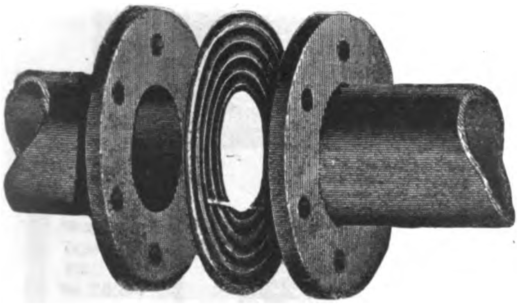
THE Norton ELECTRICAL INSTRUMENT COMPANY
No 4855
MANCHESTER, CONN. U.S.A.

Dead Beat and made for either Back or Front Connections.

The Norton Electrical Instrument Company,

Main Office and Factory, Railroad Avenue, MANCHESTER, CONN.



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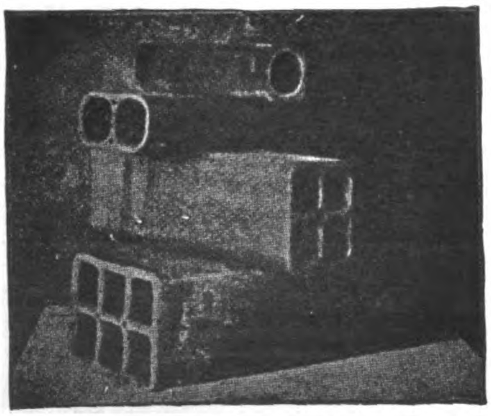

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EDITORIAL NOTES.

The London Telephone Monopoly.

While a fight is being waged in this vicinity against the New York Telephone Company, a somewhat similar struggle has been going on in England against the National Telephone Company. In the latter case, however, the unpleasantness arose not so much through high rates as on account of inferior service, due, it is claimed, to antiquated methods and apparatus.

As with the American Bell Telephone Company, the National Telephone Company in England in the earlier days got a monopoly into its own hands by buying out a number of smaller companies in the provinces. The Postmaster-General took steps, in response to public clamor, for weakening the grip of the company, by a large expenditure on trunk line communications and the provision of additional exchanges and services to be worked by the postoffice, to compete with the National Company in the London area. Municipalities also, a short time ago, embarked upon telephone schemes of their own, but their systems, where carried out, have been subjected to severe criticism from telephone experts and they have had to fight a rate-cutting competition against the National, which, having big reserve funds, could cut rates regardless of the loss which might arise in one or two places, with a view to defeating the competition. The licenses of the National Company and of the municipal corporations all expire in 1911, and as there is thus only a period of six or seven years to run, and municipalization has not been successful, much uncertainty has been felt as to what really was the best policy to give that impetus to telephonic progress that has been so long wanting in England. The position resulting from the uncertainty has been an indisposition on the part of the National Company to extend its system both in London and the provincial cities, involving heavy capital expenditure, until there was something more definite known as to its treatment by the Government when the licenses expire. The postoffice, also, has been seeming to leave new work in London very much to the company, because other claims on the Government funds stood in the way of big grants for telephonic schemes. So, between the two, the would-be user of the telephone has been deprived of the full privileges which up-to-date cities have long possessed.

This state of affairs is now practically at an end. On February 2 an agreement was made between the Postmaster-General and the National Telephone Company—subject of course to the ratification of Parliament—under which it is arranged that the existing dual arrangement over the whole of the United Kingdom is to terminate on December 31, 1911, and the lines will thenceforth be the property of the Postmaster-General. With the actual terms as to purchase we need not deal, except to say that there will be practically no payment made to the company for good will or in respect of profits, and the money will be paid by way of annuity for a term not exceeding twenty years; but the company is now assured, under this agreement, that any capital expended during the next six or seven years upon the needed extension of telephonic facilities, will not be sacrificed by it when the purchase-time arrives.

No doubt there will be many criticisms offered in regard to certain details, and some doubt is expressed as to the desirability of the system remaining in the hands of the company even until 1911; while yet others contend that the system ought not to be nationalized. But leaving aside these criticisms, the approving of the agreement will clear out of the way all uncertainty which has blocked progress during the past few years, and a big capital expenditure upon extensions to exchanges and lines, and big outlay upon all telephonic apparatus will result.

* * *

The Electrical Mysteries of the Sun.

We have held, since Helmholtz enunciated the fundamental law of the conservation of energy, that electricity is but the equivalent of some force, by whose transformation merely another phase of its existence is manifested.

This idea has been exploited for many years, and of late another presumption has followed closely on its heels—that electricity and matter are mutually identifiable. Interesting as these conclusions seem, wonders of a more fascinating nature pour down upon us from the sky, launched toward the earth with inconceivable speed from the sun. The sun sends us heat, but it also yields its myriads of electric corpuscles, which set the aurora blazing with ghostly gleams in the north and south and sends vast eddies of electricity around the earth with their fluctuating magnetic fields.

It is well to know that the sun's mass is 1,000,000 times greater than that of the earth; that a large orange and a small pin head separated from each other by several feet of space, are a duplicate of the astronomic proportions; that the convulsions and storms raging on this gigantic sphere find their echo in the far off regions of all surrounding planets, in whom, as in our own little world, electric and magnetic forces are induced to action.

It is not so many years ago that a paper was read by Prof. Pupin of Columbia University, and reinforced by experiments, in which the electrical origin of the sun's corona was demonstrated to a degree which to-day seems almost prophetic. Photographs of the natural and artificial coronæ when placed side by side seemed to have been obtained under the same conditions. It is the corona which seems to present and to contain one of the greatest of solar mysteries.

It may seem futile to spend time in speculation as to its cause or nature, but this is more than excusable in view of the inherently electrical character of this colossal phenomenon. Colossal it will be admitted to be, when the fact that coronal streamers have been measured and found to exceed 250,000 miles in length. The extreme tenuity, lambent brilliancy and unrecognizable spectroscopic character have stamped this mysterious crown of the sun as an essentially non-chemical manifestation. Thus, a new field of investigation has been opened up in this direction, supported on the one hand by purely terrestrial and in all probability, secondary evidence, and on the other hand by solar exhibitions of a primary nature that seem to originate from purely electrical causes. The latest exhibition of this kind is in the way of sun spots, which are known to appear periodically every eleven years, and give rise on the earth at such times to the well known magnetic storms, auroral lights and earth currents. We have already advanced the point brought forward by Marconi, that at night he could signal further than during the day, the sunlight seeming to interfere with the waves he projected, the cause probably being not the sunlight, but the electrons striking the earth on the bright side. This might be regarded by some as an accumulation of evidence of a most convincing nature, but the unfortunate fact remains that it has not as yet been properly correlated. It is generally admitted that the 92,000,000 miles of space between earth and sun form not so much a gap, as a link; and the ether bridge is traversed by a variety of forces, among which are certain forms of waves of which we are only now becoming conscious. Mysteries they may be to-day, but we have the hope that the newer knowledge that has and is coming, will enable us to arrange these facts in such a manner that they will present another well written page in the great book of nature.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Tuesday morning at 4 o'clock the 5,000 employes of the Subway and elevated roads of Manhattan were ordered to go on strike. It is the culmination of a dispute that began with the opening of the Subway. As we go to press—seven hours after the strike was ordered—a few trains have been run on the roads effected. There are rumors of strikes on the surface lines of New York City and Brooklyn.

◆

The Electric Bond & Share Company of Schenectady, which was incorporated at Albany last week with an authorized capital of $4,000,000, is controlled by the General Electric Company. While it is understood that the new company has no definite projects in view at the present time, its object is to investigate new electrical projects of all kinds, and if it seems advisable, to take them up. By its charter it is empowered to construct roads, tramways, railways, and hydraulic, electric and gas plants. Whatever electric supplies it will need for such work as it undertakes will, of course, be obtained from the General Electric Company.

◆

Two bills have been proposed in the Massachusetts Legislature to appoint a telephone commission to "look after the Bell Company."

◆

Marconi is credited with having invented and perfected a marvelous "wireless boat" which is expected to travel through the water at "an extraordinary high rate of speed." For the present the details of this craft are being kept secret.

◆

The next meeting of the electrical section of the Western Society of Engineers will be held at the Monadnock Building, Chicago, March 10. Mr. W. T. Benallack will deliver an address on "The Reduction of Electrical Fire Hazards."

◆

In view of the fact that the work of piercing the Simplon Tunnel is completed it is interesting to recall that it is just one hundred years since the completion of the military road over the Simplon constructed by Napoleon I to facilitate his military operations in Italy.

◆

The electrical equipment of the Times Building in this city includes 111 motors, 4,000 incandescent lamps, 15 arc and 42 Cooper Hewitt lamps. There is 74 miles of wire in the building.

◆

The figures given in the new edition of Garcke's "Manual of Electrical Undertakings" are of interest in proving, says our London namesake, how rapid is the increase in the capital invested in electrical schemes. Thus we find that in 1896 the total amount then invested represented $305,000,000, to-day it is close on $1,335,000,000. In electric lighting an average return is made of 5.03 per cent. upon a capital of $120,000,000, while in electric traction the corresponding figure is 4.33 per cent. on a capital of $305,000,000. What will be the relative importance in, say, a dozen years from the present time of the electrical, compared with other national industries, few of us are bold enough to foretell.

MODERN OVERHEAD TRANSMISSION LINES.[*]

BY G. SEMENZA.

The problem of the construction of an overhead power transmission line can be stated in exact engineering terms as follows: To support on insulators a certain number of wires so as to obtain the necessary stability of the installation with the minimum cost in capital and yearly maintenance. The construction of the transmission line demands a careful study of the topography of the track, the permissible dip of the wires, their tensions, and lastly, the strength of the supports. The forces acting on the various parts of a line are its weight, the wind pressure on wires and poles, and the weight of snow and ice it may have to carry. When the diameter and coefficient of elasticity of the wire are known, it is easy to determine the form of the catenary from the two extreme conditions—first, when under maximum stress due to weight of snow and wind pressure at the lowest winter temperature, and second, when at the highest summer temperature. The first condition gives the maximum possible tension of the wire, and the second the greatest dip of the catenary. From the latter figure, the height of the points of suspension can be determined, so that the middle point of the catenary may be never less than a safe distance above the surface of the ground.

When the track is a straight line with equal spans, the longitudinal tensions on any support balance each other, and they have then only to resist the weight of the wire and the wind pressure. For corner posts, the two tensions give an unbalanced resultant in their own plane, and further, when two spans are unequal, there is an unbalanced longitudinal tension. Thus it it easily possible to calculate the vertical and horizontal tensions which each wire transmits to the support, and, knowing the height of the wires, all the elements are to hand for the design of the supports and the foundations. The wind pressure on the post itself is small enough to be neglected.

Assuming that the amount of copper in the line has been determined from Kelvin's law of maximum economy, the following are the chief points in the erection of the line that demand attention. First of all, there is the choice of the route, and it is at once obvious that, if possible, this ought to be a straight line. For one reason, with the same percentage drop, the section of copper varies as the square of the length of the line, and if it is set out in a curve necessitating a 20 per cent. increase in length over the distance "as the crow flies," the weight of copper would be increased by 44 per cent. Then, instead of plain light poles, heavy angle supports would be necessary, and these not only represent a greater capital expense, but constitute points of weakness, as the insulators and members of the built-up post would be subjected to much higher stresses. It will always pay then, even when expropriation and way-leaves cost considerably more, to select a straight-line route.

The arrangement of lines on the supports is controlled by electrical and mechanical considerations, as the possible contacts between adjoining wires when subjected to oscillations caused by wind must be guarded against. With continuous current, the matter is quite simple, as there are no electromagnetic restrictions on the distance apart of the wires or their arrangement, and for this reason very high pressures may be used without any precautions except giving plenty of clearance. With polyphase currents, on the other hand, there must be a symmetrical arrangement of the conductors, and a compromise must be made between the mechanical and electrical exigencies. For three-phase lines, the figure of symmetry is an equilateral triangle, but it may be disposed in space in various ways; for instance, with one side vertical or one side horizontal. Although, electrically, they are equivalent, there is a marked difference in the mechanical result between the two methods, as is shown in Fig. 1 (A and B). This illustrates a section taken at the middle of the span, and the projections of the three catenaries on a vertical plane. The dimensions are in millimeters. Only the wires and insulators are shown in the diagram, the poles being omitted. With the action of the wind the wires will oscillate so that the lowest points will describe circles having as centers the projections of the supporting insulators. It will be easily seen from observation that the arc of the circle through which the wires have to travel in case A for neighboring wires to come in contact is much smaller than in B. The maximum angle through which the plane of the catenary can be displaced is terminable in each case, and in the arrangement B much larger dips, and therefore much larger spans, can be used with impunity than in A, and thus it is in every way superior.

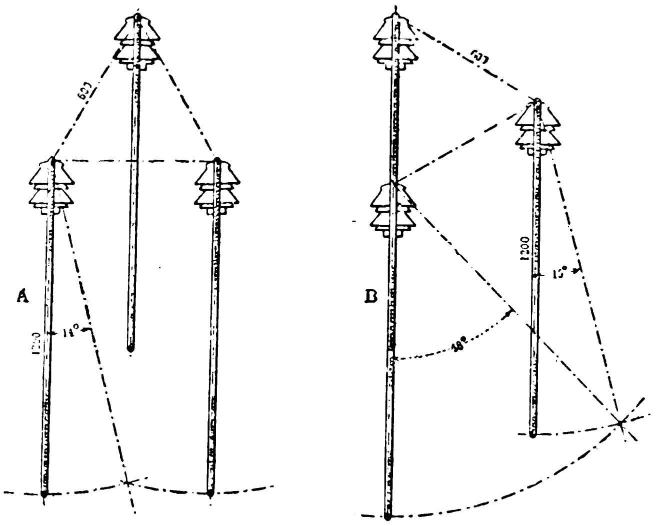

FIG. 1.

In considering wind pressure, the maximum is taken to be 280 kg. per square meter and the effective surface of the wire as its length multiplied by half the diameter. Recent experiments have shown, however, that this formula gives too high a result; but one more nearly in accord with the observed values is obtained by using the empirical formula $P = 3.10^{-5}dv^2$, where d is the dimeter in centimeters and v the wind velocity in meters per second, and P is given in kilogrammes per centimeter length. Where double lines are employed, as is usually necessary in important schemes to diminish risk of breakdowns and facilitate repairs, care must be taken to avoid having two wires in the same horizontal plane as they might touch when oscillating under heavy wind pressure (Fig. 2).

The length of the spans is not, however, controlled alone by the nearness to which the wires may approach under wind pressure. It is a very common argument to say that when the line is subjected to great stresses, due to snow or wind, long spans are inadvisable, but this is hardly true, as by using a sufficient dip the limit of elasticity of the copper need not be exceeded. By increasing the spans the number of insulators is diminished. However well the insulators may be designed they are the real points of weakness in the line, as should even one out of 10,000 break it may give rise to considerable damage.

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[*] Paper read before the Associazione Elettrotecnica Italiana. Abridged translation by John R. Dick in "Electrician," London.

The economic aspect of the problem can be realized by remembering that the increase of span diminishes the number of supports but increases their height and the stresses to which they are subjected, and therefore their weight. The most suitable span is, therefore, the one which requires the smallest weight of material per mile, and it can be only ascertained by successive approximations. Long spans, besides improving the line electrically, require less expense for expropriation or wayleaves as these costs are usually proportional to the number of supports:

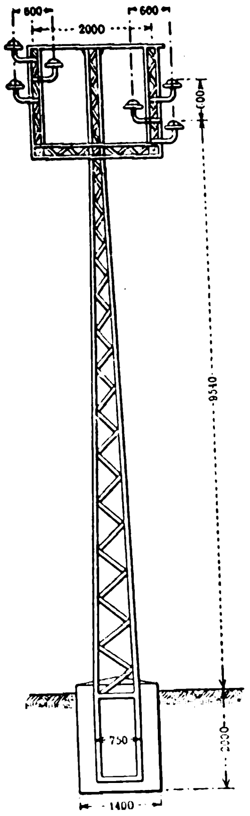


FIG. 2.—SUPPORT FOR DOUBLE LINE.

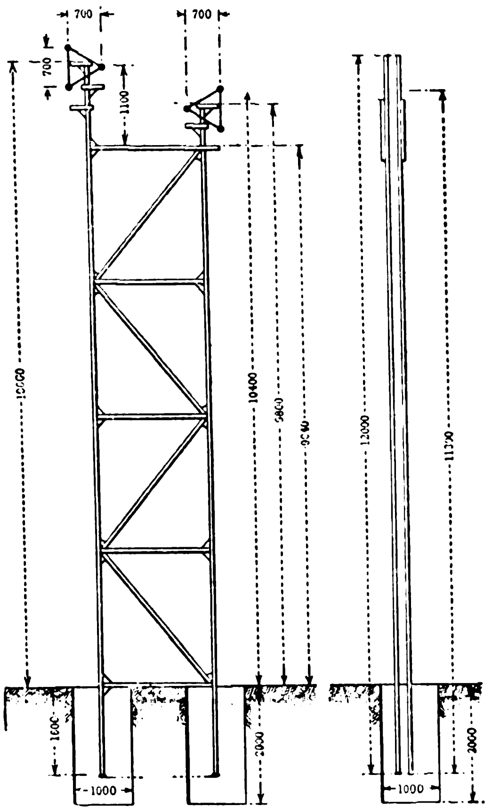


FIG. 3.—ELASTIC IRON POSTS CARRYING DOUBLE LINE.

The materials employed in the construction of the posts are wood, iron, and, to a small degree, reinforced concrete. Iron permits of long spans, because it can be readily designed to take the resulting stresses. It is, however, necessary in such cases to provide a specially heavy foundation. An economic consideration which renders iron preferable is that, as it is more durable, its depreciation may be allowed for on a 30 years' basis, whereas with wood the period is not more than eight or ten years. The annual cost of maintenance of iron poles—being only that of painting—is considerably less than for wood. Regarding the increase of insulation said to be due to a wooden pole, this is quite unimportant, and in rainy weather is not more than one-ten-thousandths that of the insulator. Although with the use of iron a short-circuit is almost certain when an insulator breaks, there is with wooden poles the peculiar phenomenon of slow combustion of the wood without the insulator being actually perforated. Mixed supports of iron and of wood partake of all the defects of the latter, such as the absence of sufficient strength and the difficulty of making a permanent joint to the iron base on account of the wood warping.

The original designs of metallic supports were excessively heavy as the calculations were made on the hypothesis of all the wires on one side breaking, but experience proves that this condition is almost impossible to occur. Any cause sufficient to break the whole bunch of wires would certainly overturn the post itself. The calculation was also based on the supposition that the post was perfectly rigid so that the breaking of all the wires on one side permitted the full unbalanced horizontal tension to come on the post, but this is found not to be the case, as the post instantly deflects and reduces the tension of the wires. If this is borne in mind, and if, also, the simultaneous breaking of only two wires on one side is allowed for, then the weight can be greatly reduced. The posts of the present Paderno transmission line with 60 meters spans were actually calculated on this basis.

Quite recently a very great improvement has been introduced in the construction of metallic supports by making them elastic. The first instance of this was in the transmission line of the Brembo scheme. The idea of this design originated from the following considerations: In a straight track and with equal spans the only force acting on the supports apart from the weight of the wire is the transverse wind pressure. It is, therefore, unnecessary to make them withstand a longitudinal stress, and they need only be designed for a transverse stress. As is seen from Fig. 3, they consist of two parallel uprights of channel iron about 2 meters apart, trussed together with angle irons. Should the wires ever get broken the supports by their elasticity will bend in the longitudinal direction, and this deflection will instantly diminish the tension. In the highly improbable case of the breakage of all the wires in one span, it is found that the first support beyond the break will deflect considerably, but as this deflection diminishes the length of each successive span, and, therefore, the tension of the wires, the second support will be deflected but to a lesser extent. The further supports will also deflect, but always to a lesser degree, and by calculation it is found that should the tension be entirely removed from one side the resulting stress would not exceed half that on a rigid support. Thus we arrive at the apparent paradox that the weakness of the support is a factor of its resistance to breaking.

Regarding the relative cost of making the line with wood or iron supports, it must be borne in mind that the comparatively small number of the latter compensates for the greater cost and the heavier foundations. Thus a line carrying six wires of 8 mm. diameter each would only cost $1,080 per mile, with elastic iron posts 15 to the mile, as against $1,005 for wooden poles 57 to the mile. With the longer life of the former the annual amount for depreciation would be very much smaller; thus the construction is really cheaper.

With reference to the general argument, it will be apparent that too much importance cannot be attached to the choice of insulators. It is a great and unjustifiable error to select those on the basis of price alone. The value of the insulators is not a great item in the total cost of the line, and a shilling more spent on each one will give an enormously increased safety in working.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

THE MOTOR.

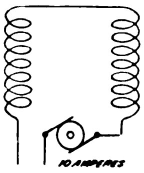
Kinds of Motors.—The motor is divided up into classes according to its winding and the character of the current employed for its operation. The direct current is used for motors wound as follows:

Constant current series wound motors.

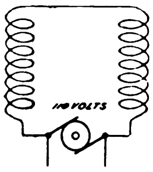
Constant potential shunt wound motors.

Constant potential differentially wound motors.

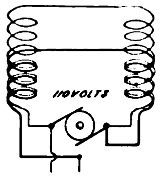
Each of these types is distinct, as far as its winding is concerned, although the last is a combination of the first two, that is, shunt and series winding. Series wound motors are employed on direct current circuits which supply constant current and constant potential. Both high tension arc light constant current systems make use of them and street railway 500-volt constant potential systems. The shunt wound motor is used for stationary work, such as the running of machine shops, printing presses, etc. It is of course possible to install series motors as well, in the places mentioned, but then there is present the ever attendant risk of high potential circuits. The system, therefore, best suited to a city's needs is a low and constant potential system, such as is found at present installed in New York. This statement is made with reference to the distribution of current; as it is now established that electric light and power systems representing work conducted on a very large scale when analyzed will be found to consist of three departments:



SERIES WOUND MOTOR
CONSTANT CURRENT



SHUNT WOUND
CONSTANT POTENTIAL



DIFFERENTIAL WINDING
CONSTANT POTENTIAL

Generation of the current.

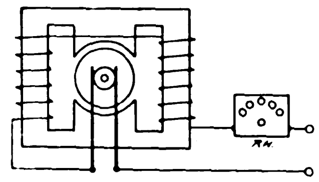
Transmission of the current.

Distribution of the current.

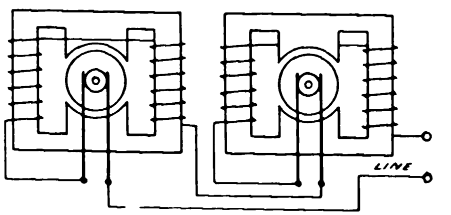
Speed of Motors.—The question of speed is a very important one in connection with motor design and construction. The two possibilities open in this direction are *constant* speed and *variable* speed. As speed in a motor is controlled by the parts which give rise to it, namely, the armature and field; and as the power of these is dependent upon the current in the armature and the strength of the field, it is evident that the question of speed is largely solved along these lines. Speed in a motor can be controlled and varied by placing a resistance in series with it and thus controlling the volts and amperes it receives; but automatic control is perhaps better represented in such cases when a constant speed is desired by differential winding. The ordinary type of shunt wound motor possesses a fairly constant speed when the load is increased or diminished, whereas the series wound motor will increase in speed as the load is reduced and decrease in speed as the load is increased. A differentially wound motor, as its name implies, is one constructed with a differential field, that is to say, a field whose magnetic strength is increased or diminished, not with the increase of the load, but reversely. In a motor of this type of winding its field is weakest when its load is greatest and its field is strongest when its load is least. Thus it seems that the question of speed is largely dependent upon the relationship between the load of a motor, its strength of field and the impressed EMF. supplied to it. Changes in these will mean changes in the speed, and by such means, it may be said, the purpose of a motor is outlined, whether for constant speed or variable speed, with a constant load or a variable load.

The Series Wound Motor in Service.—To understand the service for which a series wound motor is best suited, it is necessary to understand the influence upon it of more or less volts, more or less current and a heavier or a lighter load. To begin with, the very nature of a series winding calls for the same current in both armature and field. This fact is emphasized in order to show how responsive the motor is to such changes as may occur in the back EMF. of its armature. The current which passes through a motor may be determined by the formula:

$$\text{Current} = (\text{impressed EMF.} - \text{back EMF.}) \div \text{resistance or amperes} = \frac{\text{volts of line} - \text{back EMF.}}{\text{resistance in ohms.}}$$



Series Motor with Resistance



Two Series Motors in Series

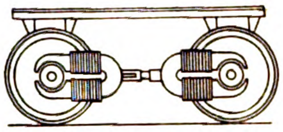
Supposing a series motor has a resistance through armature and field of 2 ohms, and its armature develops a back EMF. of 400 volts; then if the impressed or line pressure is 500 volts the current will be:

$$\text{amperes} = \frac{500 - 400}{2} = 50.$$

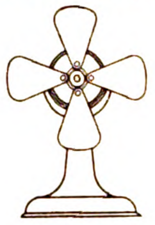
Examination of this formula will show that if the resistance is increased the amperes will diminish; also that an increase in the back EMF. will reduce the current. It will show in addition that if the volts supplied to the motor are increased, more amperes will flow; there will therefore be more torque or pull to the armature and in consequence a higher speed. Increasing the pull of an armature by increasing the impressed pressure, by reducing the resistance, or by reducing its back EMF. are clearly shown in the formula by the increase of the amperes which would thus result. Manipulation of the field strength is the means employed for affecting the back EMF.; in this case if the field is cut down either by shunting the field winding or by short-circuiting part of the lines of force, less lines of force are cut by the armature conductors and a lower back EMF. is produced. More current cannot pass in if the machine is series wound and fully loaded on a constant current circuit. Therefore under such conditions with a weakened field its pull would be reduced and its speed slackened. A series motor increases in speed as its load is reduced and diminishes in speed as the load is increased. A reduction of the load causes the then present pull of the motor to increase its speed; this also increases its back EMF. and consequently reduces the current in both armature and field. Although there is now a weaker field due to fewer ampere turns on the field magnets there is a higher speed. A still further reduction of the load will increase the speed still further until if the motor is entirely without load it will run fast enough to destroy itself.

In street railway service the series motor is used exclusively, and its regulation in regard to speed and power is carried on by a controller which throws the motor circuits from being in series with each other eventually into multiple, it being understood that more than one motor per car is in operation at a time. A series motor with a resistance box in series with it, represents in many respects the method of controlling a street car motor, only instead of a resistance of this character, its place is taken by another series motor. And thus the two series motors in series, and if necessary, with a resistance in series as well, is the present basis for street car control. Either a resistance, or another motor in series, is a means of reducing the pressure and current supplied, which is theoretically and fortunately practically a successful method of governing the speed.

From this standpoint, the motorman is merely manipulating the circuits of the series motors, so that more or less current and pressure is allowed to affect each motor individually, for the purpose of giving the car a greater or less speed. It has been stated that a series motor running idle, that is, without a load, will tear itself to pieces. In street car service, even though the car is empty, the motor has the work to do of carrying the car trucks and car body, and therefore cannot develop an abnormally high speed. But it will be readily noticed how much faster an empty car travels, than one filled with passengers. The motors in this case are taking all they possibly can in the way of current at the pressure of the line. More pressure would mean an increased speed or a more powerful field, but the limited pressure of the trolley system, 500 volts, forbids this, and the only remedy for heavily loaded cars is more powerful motors.



Constant Load on Street Railway Series Motor.



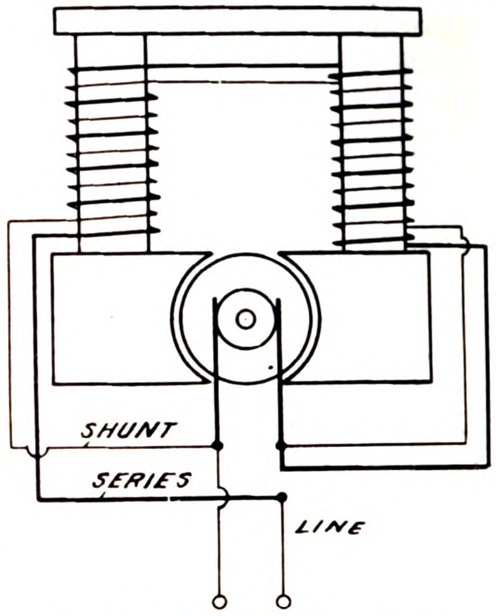
Constant Load on Series Fan Motor.

Series Wound Fan Motors.—Fan motors are series wound as a rule, unless they are to serve a different purpose from that of only running fans. A series wound motor must always be doing work when in operation, and the presence of a fan therefore represents a load which enables it to comply with the requirements of practice. Different speeds are obtained by means of a switch which governs resistance in series with the motor. At the two or three points indicated the switch allows a current of greater strength and pressure to enter which, with with the fan load permanent, permits of a higher speed. A series wound motor for the driving of sewing machines or light loads, could not be used unless there was a certainty of the load never being removed; otherwise the armature of the motor would fly apart. This form of service calls for a motor which can meet conditions of full load or no load without such an abnormal development of speed.

The Shunt Wound Motor.—The shunt wound motor is one in which the speed is fairly well preserved under all changes of load. The field winding receives its current in multiple from the line, and therefore is not affected by the changes in speed or load. The back EMF. of the armature is the regulator of the amount of current the motor takes and this in its place is determined by the amount of work the motor is doing and its effect upon its speed. As the load is increased or diminished on a shunt wound motor, the speed is affected accordingly. The back EMF. will rise or fall, which will be the means of allowing a current to flow through the armature proportional to the effective EMF. The automatic action of the back EMF. in this respect has made the shunt motor peculiarly noteworthy. Under these circumstances, it is easy to increase the speed of the motor by means of the field.

If the field of a shunt motor is weakened, the back EMF. of the armature would either drop, or (on account of the increased current which would thereby result, and necessarily the greater torque in the armature), the speed would increase. This in practice is found to be the case. That is to say, if a resistance is put in series with the field winding of a shunt motor, the speed of the motor will either increase or decrease as the current in the field winding is decreased or increased. A very interesting experiment, which carries out this idea in practice is that of running a shunt motor idle and suddenly cutting out the field winding. The effect of this, tried with a small motor, is to raise the speed to a very high point. The motor is not entirely without a field in this case, but depends upon the residual magnetism and armature reaction for such as exists. The back EMF. thus suddenly cut down, causes a powerful current to flow through the armature. The effect of this is a greatly increased torque and a higher speed, until if the motor can stand the strain it reaches a speed at which there is some approximation between the back and impressed EMF. to that existing under normal conditions. Advantage of this fact is taken in the regulation of shunt motors by the so called differential method. By this method the field is weakened when the speed slackens, as shown by the idea involved in the differentially wound motor.

Differentially Wound Motor.—The differential field is obtained by means of two field windings—one a shunt winding and the other a series winding. The shunt winding receives its current and pressure as usual from the main line, but the series winding takes the entire current of the motor. This winding is so arranged, that as the current required by the motor increases, its *demagnetizing* effect upon the field also increases. It is really a compound wound dynamo turned into a motor. Thus, increasing load means a tendency to increasing speed; which compensates for the number of turns per minute lost through the increased load. When the motor runs idle, the current in these series turns has little or no effect on the speed. In fact the motor is now a simple shunt wound machine. The disadvantage, however, lies in the reduction of the field strength when it is most needed to do the heavy work required. A uniform speed is secured by this means, within certain limits, for all changes of load.



Windings of Differentially Wound Motor.

WIRING A STEREOPTICON.

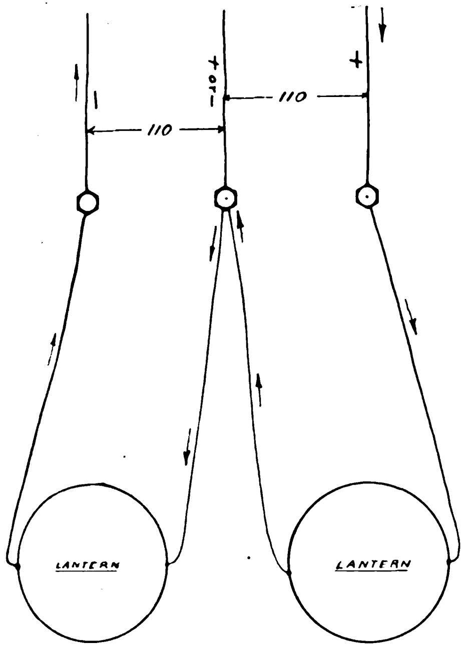
BY W. H. WAKEMAN.

Stereopticons are so extensively used at the present time, and the electric current is so often available for this purpose, giving a powerful and steady light, that suggestions concerning necessary wiring are of interest and value.

The lanterns are sometimes placed side by side, but in other cases one is located above the other. The wiring is alike practically, but the former system is illustrated for convenience.

Fig. 1 illustrates a three-wire system with 220 volts potential between the outside wires, which is "split" (according to the lineman's vernacular), giving 110 volts between each pair, as shown.

The current operates the same as if each lantern was a large incandescent lamp, for coming out over the positive wire it goes to the upper carbon, thence to the lower, giving out its bright rays as it leaps the intervening space, and if only one lantern is is operation (as when the apparatus is being started for a lecture) it goes back over the central wire. When the second lantern is connected, current flows as shown by arrows, for after lighting the right hand one it goes to the central binding post, then turns and goes to the left hand lantern, after which it returns over the negative wire. This assumes that the resistance offered by each lantern is exactly equal to that of the other. If not, the central wire either brings out or carries back enough to take care of the difference, according to which is required, therefore it is called the positive or negative wire, according to conditions.



220 VOLT THREE WIRE SYSTEM

Fig. 1.

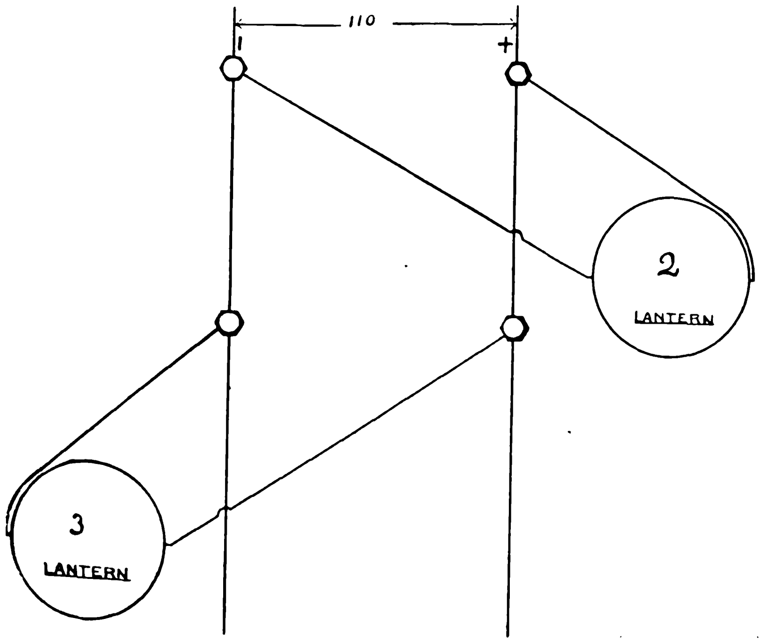


Fig. 2.—110-volt Two-wire System.

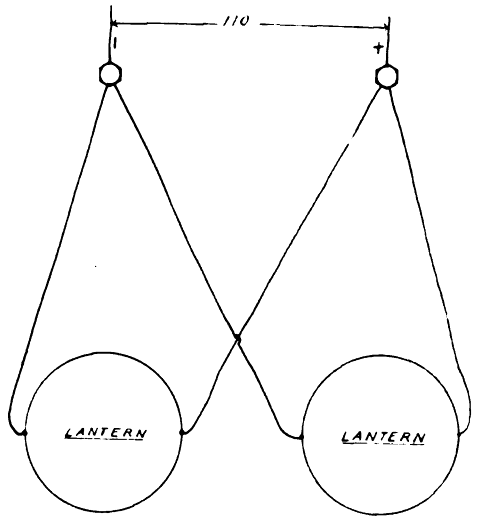
A resistance box or coil must be connected in series with each lantern, or, in other words, it must be connected so that current will pass through one, then the other. It makes but little difference whether this is located on one side or the other of a lantern, but it seems more natural to place it in the positive line. Locating it in the negative line seems like regulating the speed of a steam pump by partially closing a valve in the exhaust pipe, leaving the throttle valve wide open.

These resistance boxes are usually fitted with three binding posts. With a 220 volt current "split" as mentioned, use the two outside posts, but if it is a 110-volt current "split" making the available potential 55 volts, use the central binding post instead of one outside post.

While it is perfectly plain to everybody who understands the rudiments of electric light service, that a single lantern designed for 110 volts potential can be used on a regular 110-volt circuit without trouble, it is not so plain to all that a stereopticon in which both lanterns must have 110 volts can be used on a regular 110-volt circuit, as it is perfectly natural to think that it requires 220 volts.

At 2 in Fig. 2 we have a 110-volt single lantern on a 110-volt circuit. Going on further we find another single lantern at 3 and they are connected in parallel. Why should they not be connected as shown in Fig. 3, where both are equal? Certainly there is nothing either in theory or practice to prevent it, yet I have been told that it cannot be done, and not by an amateur either.

If a 110-volt circuit is available and a stereopticon adapted to 55 volts is to be used the lanterns may be connected in series as shown in Fig. 4. Under these conditions one will not light until the other is also ready, when both will shine together. A disadvantage of this plan is that if anything happens to one, the other will go out too, thus leaving the operator in trouble, whereas if they are connected in parallel or multiple, failure of one does not affect the other. While this would spoil the dissolving effect produced by two lanterns properly adjusted, it does not prevent the lecturer from finishing his entertainment, although the pictures appear at a slight disadvantage.



110 VOLT TWO WIRE SYSTEM

Fig. 3.

Sometimes we attend a lecture and find that the stereopticon is not operated to the best possible advantage. This may be due to the fact that the operator appeared on the scene 15 minutes before the lecture began, assuming that everything was ready for him when it was not.

Such a plan will answer very well for places where a stereopticon remains in one place for a long time, such as in a lodge room, where it is always used in routine work, provided it is cared for exclusively by one man. The writer has been engaged in this work for several years, thus learning something about it. There is no chance to try a stereopticon before it is wanted in such a place, as the room is in use for other purposes. When the pictures are wanted they must appear at once, and be right too.

Of course practice makes perfect here as elsewhere, therefore even when new carbons are required they are put in and the stereopticon used at once without previous trial. The arc must be accurately centered in order to secure good

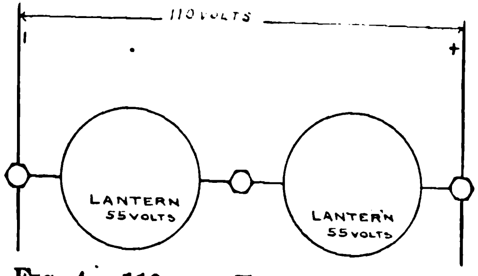


Fig. 4.—110-volt Two-wire System.

results, so that a system of measurements must be adopted which will enable the operator to fix his light at a given height.

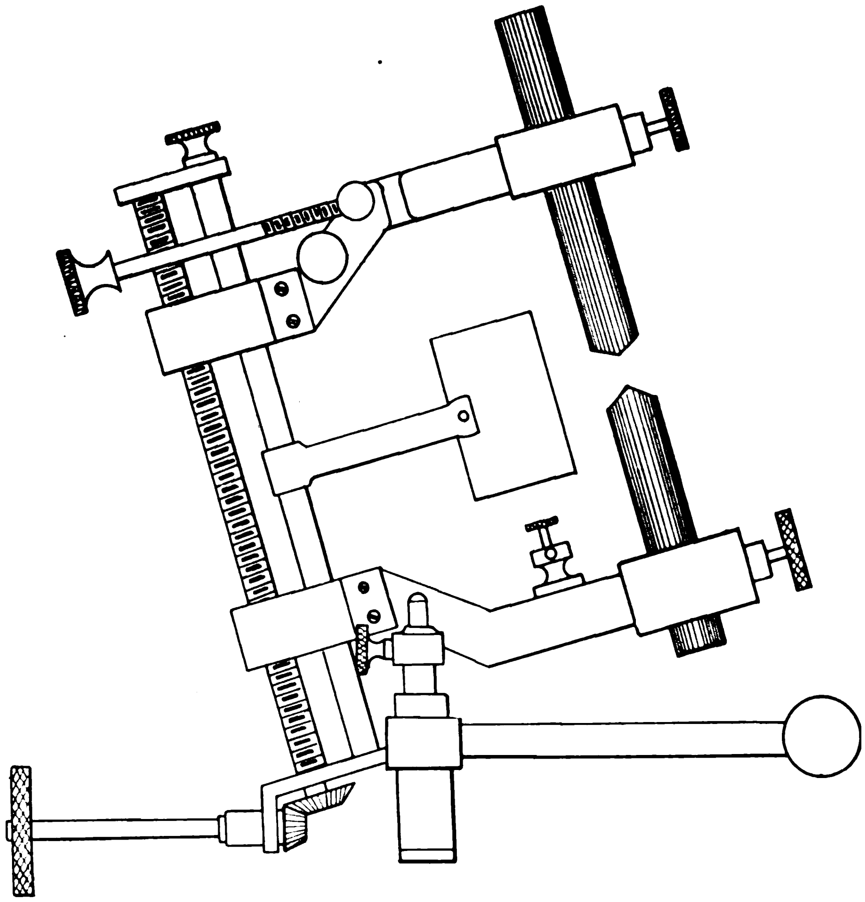


Fig. 5.

While the carbon holders are adjustable by screws, the frames are held in place on the posts by means of set screws. The latter adjustment must be made permanent, then the lower carbon can be set right, taking an opportunity when it is possible to try the light and set it so that neither shadow nor blue cloud will appear on the screen.

Having secured this on one, the other can be set just like it, taking care to measure the length of carbon used on the upper part.

When setting up a stereopticon for use on a direct current, it is necessary to know that it is wired so that current passes down the upper to the lower carbon for the following reason. The carbon which receives current first burns much faster than the other, as particles seem to be taken from it and deposited on the other. The screws are given pitches that make them travel accordingly, thus always keeping the arc central, but the upper thread is much coarser than the other, or else the arc would remain central but a short time.

To test the wiring proceed as follows: Make necessary connections and turn on current; let it remain on for about 5 minutes, then turn it off and watch the ends of carbons. If the upper one remains red longer than the other, it receives current first and is therefore positive, which is correct. If the lower retains the red color longer, the wires are connected wrong and must be reversed.

Because the wires are connected correctly at first, is no guarantee that they will always be so, because a stereopticon usually takes current from an incandescent lamp system, and for this service the current may travel in either direction and work equally well, therefore if the electric station employes change the wires while making repairs or renewals, they consider that no harm is done.

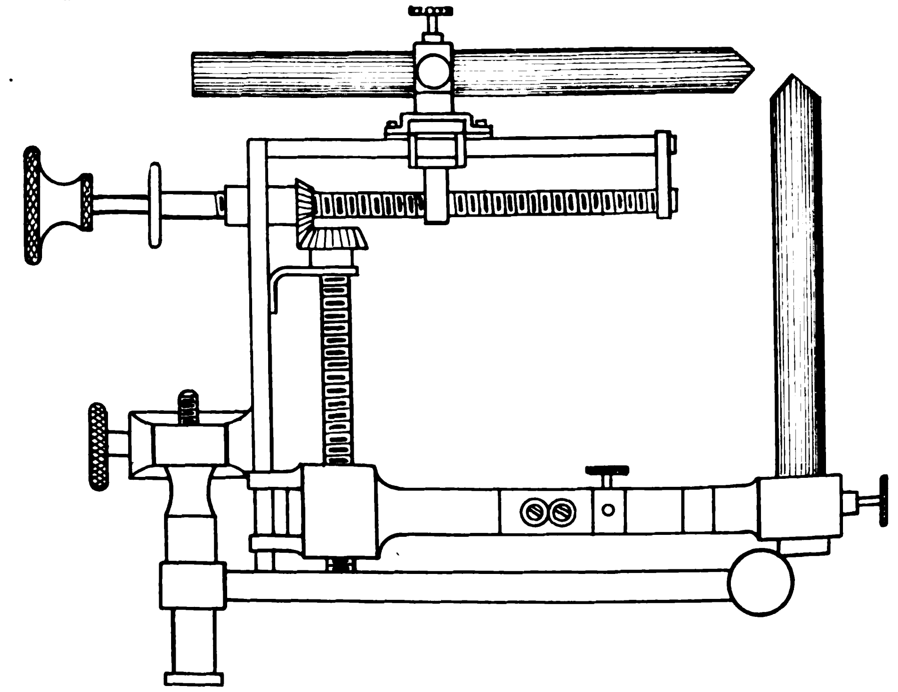


Fig. 6.

An incident of this kind nearly spoiled the operation of my stereopticon one evening, but it was discovered in time to prevent trouble. While making repairs, linemen had reversed the street connection, thus causing current to travel in the opposite direction.

Where an alternating current is used, wires may be connected in the most convenient way, as it makes no difference with the carbons, for both burn away equally. This calls for different regulation, which is secured by giving the upper and lower threads equal pitch, thus moving the carbons alike.

These arcs generate much heat, therefore when first turned on they should be at least 8 inches distant from the condensing lenses. After burning a few minutes in this position they may be slowly moved forward until in their proper places. This results in gradually heating the lenses, thus avoiding unequal expansion which may break them. I have seen a fine set ruined by heating them too quickly, although the culprit was a professional operator.

Automatic carbon feeders are considered superior by some operators, but the simple hand feeder is not without advantage, for it is always under control, while the more expensive kinds are much more liable to fail when wanted badly, to my certain knowledge.

The hand feeder needs slight adjustments at frequent intervals, but this can be done without interfering with other duties.

There are two good ways of locating carbons in a stereopticon, one of which is shown in Fig. 5. Here both are in line, but are set at an angle to the perpendicular. The object is to present the lower end of the upper carbon to the lense, as here is where the light is brightest. It answers this purpose well, giving a powerful light that will show across the largest halls and lecture rooms we have.

Fig. 6 shows another plan for locating carbons in which the positive is horizontal and must be wired accordingly to receive the current. The negative is vertical and is connected to the return line of the circuit. This refers to a two-wire system. If put on a three-wire system it is wired as shown in Fig. 1.

SERIES ALTERNATING ARC LIGHTING.*

BY E. P. WARNER.

(Continued from page 126.)

PRACTICAL ARC LIGHTING.

In the past we have heard much regarding the relative lighting efficiency of different classes of arc-lamps; the change from an open arc system to the alternating inclosed arc system often brings up the question of comparative intensity of light. Lighting committees and station managers must be satisfied regarding that point before they can make an intelligent selection of a system. The old commercial standard open arc lamp of 450 watts or 2,000 nominal candle power as adopted by the National Electric Light Association has been an accepted standard for many years. Lamps of lower wattage have been used extensively, but the 450 watt lamp has come to be pretty generally recognized as best adapted for street lighting.

A 450-watt alternating inclosed arc lamp is fully equal to the old open arc direct current for street illumination in respect to the amount of light given, and far superior to it in the matter of lighting effect as demonstrated by the increased field of vision. The bright ring of light on the street, and the dark spot under the open arc lamp are familiar to us all, but with the inclosed arc both are absent and a good average illumination of this field is obtained which, for the purpose of vision, is much to be preferred. At a distance of 150 feet the light from the alternating arc fully equals that of the open arc and beyond that distance the difference is distinctly in favor of the former. I am here proceeding on the assumption that lamps are hung at the same height. We find, however, that the alternating lamp may be hung three or four feet lower than the open arc, with a still further improvement in the effective illumination.

In the substitution of series illuminating arc lamps for the open arc in tower lighting the results have been exceedingly gratifying. Lamps were used of about 420 watts at the arc with 18-inch metal shades, white enameled on lower surface. It was found that the light at and near the base of the tower was very much greater, while the general average lighting at a distance from the tower was fully equal to that given by the open arc. No adverse criticism of the conditions after the change was offered by the people living in the neighborhood, and quite a number of favorable comments were volunteered touching the increased steadiness and more uniform distribution of the light.

CENTRAL STATION EQUIPMENT.

In the equipment of a station for the operation of series alternating arc lamps, the choice of suitable switching and controlling devices becomes an important matter; not that these details are extraordinary in number or complication, but for the reason, as often happens, that there are several good ways of doing the same thing.

A switchboard should have a system of stab switches, one for each of the two terminals of a circuit, so arranged that it may be transferred from one system of supply to another, and so that any circuit can be readily disconnected from its source of supply. The first provision is made with a view to permanency of operation of a circuit. Failure of a transformer or regulator should not compel the shut-down of a circuit for more than a very short length of time, and a simple means should be provided for bringing into service a new source of supply. This is ordinarily an extra regulator and transformer properly installed and connected to the switchboard, held ready for use in emergency. In very large installations it is necessary to have a number of such extra transformers and regulators, with connection busses running the entire length of the board, thus permitting the connection to any arc circuit by means of stab switches. Transfer busses for interchanging the circuits are not used in the present practice to any great extent, it being found unnecessary to make transfers very frequently or to any very great extent. A good reliable ammeter should be installed in each of the arc circuits. This need not be an expensive instrument, but should be one reasonably accurate and allowed to always remain in circuit while same is in use. Where very high potentials are used, it is customary to use a current transformer to actuate the ammeter in order to insulate it from the circuit and thus render it more safe to handle, and reduce the liability of crossing to other instruments on the board. Where aerial lines are used, a good system of lightning arrester should be installed at a point on the circuits immediately after entering the station. It has been found desirable to disassociate the lightning arrester installation entirely from the switchboard proper, making it a special feature of the installation.

Transformers and regulators can be installed in a separate room or building, if desired, and generally speaking this is a good plan, for the reason that it more or less isolates different portions, thus reducing the risk of injury or loss from fire. The transformers used in many of the systems, where inductive regulators are employed, are of the ordinary constant potential type and may be either oil insulated or air cooled. Generally speaking, the efficiency of these transformers can be as high as that of ordinary constant potential transformers used with non-inductive load, and the combined efficiency of a transformer and inductive regulator supplying an arc circuit is fully equal to that of the best form of tub transformer under any stage of load.

The usual practice to-day in the matter of regulators is to have all regulators of full load capacity so that they not only serve as current regulators for small changes of load and voltage, but act also as safeguards in case of a complete short circuit of an arc circuit. Arguments have been advanced against this practice, claiming that it was unnecessary to provide such an extreme range of regulation and that safety from short circuits could be provided by more inexpensive means. Whether this is true or not has not been demonstrated by any very extended practice.

Of all automatically operating regulating devices known in the engineering world to-day, the inductive regulator stands forth as one of the most perfect pieces of electrical mechanism known in the art. It has been found so perfectly reliable in its operation that the average station manager will question the accuracy of his ammeter before he will that of the regulator.

It is not an uncommon thing to hear the remark made when the current reads wrong, that "the ammeter must be off." A regulation of current to within 1-10th of an ampere, under quite extreme fluctuations of load and voltage, is easily accomplished, and this so quickly that there is scarcely a noticeable fluctuation of the lighting power of an arc lamp in series, even when 10 or 15 per cent. of the lights are extinguished at once. It is not a good plan to have regulators retarded by the action of the dash pots or other retarding devices. Perfect reliability of action is best secured by leaving the coil free to move and relying on the magnetic conditions to bring about stability in action and position.

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* Paper read at the 13th annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 18-20, 1905.

In the mechanical construction of regulators it should be observed that they are strong, accessible, free from excessive friction in all moving parts, readily adjustable to load conditions and capable of operation at high efficiency and power factor, and operate with little if any noise. Electrically they should be well insulated, sufficient ventilation should be provided in all portions of the windings to prevent accumulation of heat and excessive high temperature in any part.

(*To be continued.*)

ELECTRIC RAILWAY OPERATION IN A GREAT CITY.

During the course of a carefully prepared speech, delivered at the 248th meeting of the New York Electrical Society on February 15, Herbert H. Vreeland, president of the Metropolitan Street Railway Company, exhaustively reviewed the question of urban transportation. He neglected no side of the matter, taking up its physical and financial phases, which he discussed with the authority to which his long and wide experience in this particular field entitles him.

Mr. Vreeland apologized for the sermonizing tone his address took on in parts, but he declared it was impossible to dissociate his words from this element, particularly when he undertook to point out the method in which progress and evolution had been utilized in the solution of the confronting problem. He found the personal element to play no insignificant part in the recognition of such advances, and, with the poet, extolled "the uses of adversity."

"You are dealing with the most interesting problem that now engages the practical ingenuity of men," said Mr. Vreeland in his opening. "The azure of speculation seems nowhere so illimitable as in the region which your science seeks to explore.

"The world is as little interested in the man of affairs and action who gets too far ahead of the procession as in the laggard who falls behind. Living in the future is fine, but living in the present is more comfortable. If you are going to be useful, or at all events, successful, you must train your minds in the accomplishment of something out of which your contemporaries can take credit and satisfaction, and there is nothing in which their interest is keener than in the thing that facilitates the present doing of each man's present business. This is the problem of transportation."

Apart from the many and varied uses in which new inventions make possible the employment of electricity, Mr. Vreeland indicated the greatest value to be obtained from those discoveries which permit application for the betterment of existent conditions. There is a system in everything, he declared, and he endeavored to explain and eulogize the system of street railroad operation so that the trained minds of his hearers might be able to discern which parts were permanent and susceptible to improvement and which were or soon would be ready for displacement. The matter of city transportation he believed to be one of the most important among the world's "wants." Discussing this, the speaker said:

"The temper of the people is the most important part of every great question today, whether it is a question of private business or public affairs. The public never troubles itself to be consistent. It is no odds to the public that what it wants to day is in conflict with what it wanted yesterday. In the same breath, indeed, it will insist upon certain conditions, and then demand results that can flow only from conditions precisely the opposite. This is well illustrated in the controversies that are now going on about combination and competition in great industrial enterprises. Profoundly offended at the perils—mostly fancied—to which combination exposes the public interest, its every agent, the press, the public, the bar, the legislatures and the courts, will nevertheless require those useful results that only combination will produce. You are listening to-day to a large chorus of demand that there shall be free and open competition among transportation companies, and from the same voices an equally loud demand that the passenger shall be carried between the furthest extremes for the smallest fare.

"To-day the street surface railroads are combined throughout Manhattan and the Bronx; but combination will not end there," he went on. "I speak now not as a railroad president with a business scheme in his head; I speak as a student of material conditions to other such students. The public demand for facilities, for convenient routes and cheap fares is never hushed. Concession only serves to provoke a larger demand, and at the very bottom of every question that can arise in your minds as to how you will adapt the power of electricity to the problem of transportation must be to help the railroad to discover a means of satisfying this inevitable public requirement consistently with the right of its stockholders to expect a dividend upon their investment."

He was convinced, said the speaker, that with the general development of the system, due to new inventions and perfecting the old ones, the employment of electricity "in the movement of trains over long distances is close at hand." When he viewed the fact that the evolution of the horse drawn, railless omnibus into the modern electric car was the work —wonderful as it seemed—of less than twenty years, he was at a loss to attempt to place limitations upon the accomplishments of the future.

Then Mr. Vreeland took up the economic side of the question. He said: "It is fortunate for you that in these days of combination the president of a great corporation is no longer its owner with his thoughts solely upon the immediate recovery of his investment. Combinations —call them trusts if you prefer—by the very fact that they represent so great an investment that no one man—indeed, no small group of men—is ever in secure and absolute control, afford the best assurance that any business method has ever provided in the history of trade of the largest opportunity for men of force and brains. The ownership of a property capitalized for $25,000,000 or $50,000,000, bonded for $50,000,000 or $100,000,000, is distributed all over the country and lodged in the hands of thousands and often tens of thousands of investors.

"However identified it may be in the mind with the genius of a single individual who may have created or brought it together, the fact invariably is that his personal financial interest in the concern bears only a trifling proportion to the total investment, and well he knows that his control is no control at all, but merely that measure of authority which he can justify by an annual dividend. He knows, moreover, that its continuance depends not so much upon what he can accomplish to-day as upon the steady, constant and permanent value that he can give to his corporation's securities. He and his associates—for of himself he amounts to little—perfectly realize that they must keep their eyes constantly trained on the future, and their minds are always receptive, therefore, to a man with an idea."

One attack upon combinations Mr. Vreeland answered in these words: "You are all familiar with the claim that the consolidation of great properties is against the interests of the individual, of labor as a class, of inventors as a class, of youth and ambition however employed, unless it is backed with money. It is constantly alleged with most elaborate sophistries that the ultimate result of consolidations is a reduction of working forces and that the effect of elaborate organization is to thwart ability and stifle hope. I suppose that, in a modified way, the experience of my corporation is that of every other. If it is, this is the fact: Computing on a mileage basis, since the street railroads of New York City were consolidated into the Metropolitan system, and since the electrical engineer drove the electrical force against the wheels of our cars, we employ three times the number of men that were formerly employed upon the same mileage. We have one president, it is true, instead of twenty odd, and we have reduced the number of secretaries, managers, treasurers and superintendents and the like, but as to the working force, from which the loudest protest is heard against combination, it is three times as great and its wages per individual have increased 15 per cent.

"Favoritism is a bygone method," said Mr. Vreeland. "In our organization," he continued, "we are absolutely dependent upon ability. What should an electrical engineer, who is a director's son, but a man of no particular capacity, weigh with me against an electrical engineer through whose device I can start my cars more easily, stop them more swiftly, govern them more accurately, when my relation to my company depends solely upon the value of securities owned by ten thousand individuals scattered throughout the land? Influence may secure to youth an opportunity, it may set his foot in the right direction, but there never was a time when the length of his stride depended so entirely upon the man himself as they do to-day."

Mr. Vreeland deprecated the too rapid advancement of electrical science from the standpoint of economy. "It is no unusual experience for us to buy and install a very expensive electrical device," he said, "to discover that it does not work in perfect synchronism with other parts of the machine or with other machinery necessary to be operated with it, and to have it said to us:—'Nothing ails the new motor; it is a good motor. What you want is a new governor. Since we made that motor we have made some other new thing to go along with it; you must get that.'"

Proposals Invited.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until March 21 for furnishing the New York, Boston, League Island and other Eastern navy yards with the following: Schedule 99, electric cable; schedule 100, electrical supplies. Blank proposals will be furnished on application to the Navy Pay Office in New York or to the Bureau at Washington. Applications should designate the schedules desired by number.

The Bureau of Yards and Docks, Navy Department, will open bids on April 15 for furnishing a five-ton electric traveling crane at the Puget Sound Navy Yard. Specifications can be seen at the Bureau or will be furnished on application to the commandant of the yard named. On April 1 the Bureau will open bids for furnishing three electric traveling cranes at the Portsmouth, N. H., Navy Yard.

F. A. La Roche Dead.

F. A. La Roche died in the Presbyterian Hospital, New York, Saturday morning of a complication of diseases. He had been ill for about six weeks. He was forty-three years old, and was interested in various electrical and motor companies.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED FEB. 28, 1905.

Electric Railways and Appliances.

783,458. Trolley. James A. Norton, Wilkes-Barre, Pa., assignor of one-half to William L. Raeder, same place. Filed Dec. 23, 1904.

783,687. Electric Railway. Alfredo Diatto, Turin, Italy. Filed Nov. 20, 1902.

783,751. Insulated Railway-Rail Joint. Edward D. Lewis, Syosset, N. Y., assignor to the Continuous Rail Joint Company of America. Filed June 1, 1904.

Electric Lights and Appliances.

783,509. Electric-Lighting System. Albert G. Davis, Schenectady, N. Y., assignor to the General Electric Company. Filed March 4, 1899.

783,645. Electric Lamp and Socket. Charles G. Perkins, Hartford, Conn., assignor to the Perkins Corporation, same place. Filed July 30, 1904.

783,737. Electric Candelabrum. Charles E. Weeks Providence, R. I., assignor to the Gorham Manufacturing Company. Filed June 30, 1903.

783,741-743. Electric-Lamp Adjuster. Henry D'Olier Jr., Philadelphia, Pa. Filed March 5 and April 2, 1904.

783,876. System of Electric Lighting. John Lindall, Boston, Mass. Filed Oct. 17, 1904.

783,974. Electric-Arc Lamp. Charles A. Nagel, Allegheny, Pa., assignor of two-sixths to William G. Anderson, and one-sixth to Max E. Nagel, same place. Filed April 14, 1904.

Electrical Machinery and Apparatus.

783,409. Frame for Dynamo-Electric Machines. Bernard A. Behrend, Norwood, O., assignor, by mesne assignments, to the Bullock Electric Company. Filed Nov. 6, 1903.

783,430. Insulating Base-Block for Electric Equipment. Monroe Guett, Hartford, Conn., assignor to the Hart & Hegeman Manufacturing Company. Filed June 13, 1904.

783,462. Time-Limit Starting and Controlling Rheostat. Robert H. Read and William O. Yates, Schenectady, N.Y., assignors to the General Electric Company Filed July 21, 1904.

783,495. Oscillator for Electric Machines. Edwin C. Wright, Newport, Ky., assignor, by mesne assignments, to the Bullock Electric Company. Filed May 26, 1902.

783,503. Temperature-Compensating Device for Thermo-Electric Measuring Instruments. William H. Bristol, New York City. Filed Dec. 15, 1904.

783,508. Emergency-Brake. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Filed June 16, 1904.

783,513-514. Regulator. Richard Fleming, Lynn, Mass., assignor to the General Electric Company. Filed Sept. 26, 1903, and April 25, 1904.

783,532-533. Transformer and Transformer Protection. Walter S. Moody, Schenectady, N. Y., assignor to the General Electric Company. Filed July 21 and July 25, 1904.

783,537. Motor-Controller. William A. McTaggart, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 15, 1904.

783,543. Electric Chain-Welding Machine. Adolph F. Rietzel, Lynn, Mass., assignor to the Thomson Electric Welding Company. Filed Oct. 15, 1903.

783,557. Power-Transmitter. Calvin P. H. Vary and Hermon D. Hutcheson, Newark, N. Y. Filed Dec. 9, 1903.

783,612. Electric Switch. Percy L. Clark, Bristol, Conn., assignor to A. L. Clark, Elgin, Ill. Filed June 23, 1904.

783,651. Transformer for Electric Metal-Working Apparatus. Elihu Thomson, Swampscott, Mass., assignor to the Thomson Electric Welding Company. Filed Dec. 4, 1903.

783,911. Electric Push-Switch. George B. Thomas, Bridgeport, Conn., assignor to the Perkins Electric Switch Manufacturing Company, same place. Filed June 13, 1904.

783,965. Commutator. Hermann A. Knoener, East Orange, N. J., assignor to the Crocker-Wheeler Company, Ampere, N. J. Filed July 25, 1904.

783,977-978-980-981. Electric Switch. William H. Powell, East Orange, N. J., assignor to the Crocker-Wheeler Company. Filed Nov. 28 and 30, 1903, and Oct. 24, 1904.

783,979. Rheostat. William H. Powell, East Orange, N.J., assignor to the Crocker-Wheeler Company. Filed Oct. 24, 1904.

783,989. Apparatus for the Commutation of Direct-Current Dynamo-Electric Machines. Frederick W. Young, Ampere, N. J., assignor to the Crocker-Wheeler Company. Original application filed April 17, 1902. Divided and this application filed June 26, 1902. Renewed Sept. 12, 1904.

Telephones and Telephone Apparatus.

783,419. Telephony. Edward A. Buell, Dekalb, Ill., assignor to the Selective Signal & Telephone Manufacturing Company, Sycamore, Ill. Filed May 2, 1904.

783,510. Telephone-Exchange System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed May 20, 1903.

783,750. Phonic Apparatus. Daniel Higham, Bridgeport, Conn., assignor to the Highamophone Company, Jersey City, N. J. Filed Dec, 12, 1904.

783,861. Telephone-Switch. Albert W. Hammer, Willow, Ind. Filed Jan 25, 1904.

Miscellaneous.

783,480-481. Starting Means for Gas or Vapor Electric Apparatus. Percy M. Thomas, Pittsburg, Pa., assignor to the Cooper Hewitt Electric Company. Original application filed Feb. 3, 1903. Divided and last application filed May 6, 1903.

783,482-784,016. System of Electrical Distribution. Percy H. Thomas, Pittsburg, Pa., assignor to the Cooper Hewitt Electric Company. Original application filed Feb. 7, 1903. Divided and last application filed May 6, 1903.

783,546. Insulation for Edgewise-Wound Coils. George H. Rupley, Schenectady, N. Y., assignor to the General Electric Company. Filed July 21, 1904.

783,708. Generating Low-Frequency Currents. William Stanley, Great Barrington, Mass. Filed Nov. 11, 1903.

783,809. Electric Elevator. Ernest H. Vogel, New York City. Filed April 11, 1904.

783,996. Burglar or Fire Alarm System. John W. Culp, Elkhart, Ind., assignor to the Modern Burglar & Fire Alarm Company, same place. Filed June 28, 1904.

784,013. Method of Generating Low-Frequency Currents. William Stanley, Great Barrington, Mass. Original application filed Nov. 11, 1903. Divided and this application filed July 7, 1904.

THE TELEPHONE WORLD.

Independent Companies Hold Annual Meeting.

Over 50 stockholders, officers and managers of the 28 Independent telephone companies in the Sixth District of Ohio, comprising Montgomery, Miami, Darke, Shelby, Clark, Greene, Champaign, Logan and Madison Counties, met at the Dayton Home Telephone Company Building a short time ago and talked business. In that district there are 30 exchanges, 1,482 stockholders and 25,000 subscribers.

I. H. Theddick, of Sidney, was elected vice-president, and H. P. Miller, of Dayton, was chosen to represent the district at the meeting of the National Independent Telephone Association in Chicago, June 20 and 21.

Charles E. Guile and A. M. Taylor, of Penn Yan, N. Y., representatives of the Inter-Ocean Telephone & Telegraph Company, have been in the vicinity of Poplar Ridge and Scipioville, in an effort to organize an Independent telephone system for the benefit of the farming community and others who desire such a service. It is understood that a company is about to be organized, to be known as the Inter-Laken Telephone Company, which will furnish the capital and commence construction as soon as the weather conditions will permit. The best of material and telephones will be used, and everything will be put up in first-class order. The company will be connected with the Inter-Ocean Telephone Company at Auburn, thus giving the long-distance service. It is expected to reach King's Ferry, Aurora, Scipio Center, Fleming and all intermediate points.

The Dakota Central Telephone Company has completed arrangements for the construction of an extension from Gettysburg to Pierre, S. D., and work will begin as soon as the ground thaws. The proposed extension is a completion of the line from Bowdle to Pierre, which was started some time ago, operations being suspended when the capital fight commenced. Another line will be built in a short time from Ipswich south to Faulkton and Miller, over 100 miles of main line wires being planned in the next few months in the extensions mentioned.

John Woodward has organized a company to be known as the Cumberland River Telephone Company, and will begin at once to construct lines from Barbourville, Ky., to Keely, Tenn., via Williamsburg. Material for the line has been bought, and the company will be incorporated at once with a capital of $5,000. John Woodward will be president and general manager, and L. R. Benjamin, of Barbourville, secretary and treasurer.

The Clearwater, Minn., Telephone Company has arranged to connect with the Northwestern Telephone Company, and is wiring the town and putting in a large switchboard.

The Western Wisconsin Telephone Company of Arcadia has filed an amendment to its charter increasing its capital from $50,000 to $60,000; John G. Gaveny, president, and Emil Maurer, secretary.

The Nebraska Telephone Company has begun the installation of an exchange at Raymond.

Independent Telephone Men Hold Interesting Meeting.

Independent telephone interests were thoroughly considered at a meeting held about a week ago at the Hartman Hotel, Columbus, O., of representatives of the 160 exchanges in two districts comprising 24 counties, including Franklin and others in the southern part of the State.

The conference was presided over by Dwight E. Sapp, of Mt. Vernon, and among the 100 telephone men present were: J. B. Hoge, of Cleveland, president of the National Organization; Frank L. Beam, president of the Ohio Independent Telephone Association, and M. B. Overly, general manager of the United States Telephone Company.

There was a general discussion of telephone conditions, from the viewpoint of the Independents. Among the subjects considered were the recognition of the rights of the different companies; rules governing the operation of the exchanges; uniform system of bookkeeping, publication of telephone directories and the best method of advertising.

President Frank L. Beam of the State Association read an interesting report of the business of the Independents, compared with that of the Central Union, in the two districts. He presented this table:

	Ind.	C. U.
Number exchanges............	160	28
Number toll stations............	360	132
Number subscribers............	43,923	15,078
Number stockholders............	1,575	0
Number companies............	63	1
Age companies, oldest.........	8	20

The counties included in the districts represented are:

Ninth district—Crawford, Richland, Ashland, Wayne, Holmes, Morrow, Knox, Union, Delaware, Licking, Franklin, Fairfield and Hocking.

Fourth district—Pickaway, Fayette, Vinton, Jackson, Scioto, Lawrence, Pike, Adams, Highland, Clinton and Ross.

Delegates on a basis of one for each 1,000 'phones were elected to the State Association, which meets in Columbus on March 30. Officers were also elected for the two districts.

The meeting was probably the best attended in the history of the two organizations, and according to one of the officers, is an indication that the Independents are enjoying prosperity.

The Lorimer Automatic Telephone Company was lately organized at Augusta, Me., for the purpose of dealing in apparatus and property pertaining to the complete operation of telephone lines or systems. Its capital stock is $10,000,000. The officers are: President, G. R. Hadlock; treasurer, E. F. Whittum, both of Augusta.

The Belmont Telephone Company, of Bellaire, O., has purchased the Pultney Company's telephone lines which are operated at Shadyside.

The Guysville, O., Telephone Company has increased its capital from $3,000 to $6,000.

The Central Telephone Exchange Company has been granted a franchise in Rogers, Ark.

Telephone Improvements.

H. J. Pettingill, president of the Northwestern Telephone Exchange Company in Minneapolis, is about to take up the building of several hundred miles of pole lines in new territory. It is planned also to string 2,000 miles of copper on toll lines in the three States in which the company operates. Important long-distance extensions are considered also.

The operation of the toll service in the twin cities is to be consolidated in the new East Side Building. The Northwestern Company will connect there with the operating service of the American Telegraph & Telephone Company of Chicago.

The opponents of the Bell Company are determined to establish an Independent telephone service in Middletown, N. Y., and it has been decided to organize a new Independent company there to be ready to make contracts and secure any desirable property.

A meeting will be held by the stockholders of the Dundee. N. Y., Telephone & Telegraph Company, Friday, March 10. The stockholders are desirous of increasing the capital stock of the company to the amount of $10,000, and the meeting is called for that purpose.

A new telephone company, capitalized at $4,000, has been formed in Candor, N. Y.; another concern known as the Rose Telephone Company of Bloomville, N. Y., with a capital stock of $15,000, has also been organized.

The telegraph and telephone apparatus in Japan is of the most modern type. Tokio and Yokohama installed their first telephone systems in 1890.

R. H. Porter and E. W. Porter have organized the Potlatch Telephone Company and will engage in the telephone business in Juliaetta, Kendrick, Southwick and Leland, Idaho, as well as through the country adjacent to these places.

The Pope County Telephone Company, of Golconda, Ill., has increased its capital stock from $5,000 to $15,000.

More than $200,000 will be spent by the Colorado Telephone Company in extending its line in New Mexico.

The Lebanon Telephone Company is to operate lines throughout New Jersey.

The Atlantic City, N. J., city council has decided that telephone and telegraph wires must be placed underground.

Telephone Incorporations.

The Maple Lake Telephone Company, Maple Lake, Minn. Capital stock, $10,000. Incorporators: A. W. Mary, F. S. Bissell, P. H. Lealey, W. E. Freeney and J. E. Madigan.

The Hector Telephone Company, Hector, Minn. Capital stock, $25,000. Incorporators: Emil Larson, Edwin Dahlgren, Justin Johnson and E. M. Ericson, Palmyra; Harry L. D'Arms, Henry L. Torbenson and George S. Eichmiller, Hector.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Aguilar, Col.—A company with a capital of $10,000 is being formed to construct a municipal electric light plant here. A. R. Lindsey, Morris Pitts, H. Pinamonti and Dr. A. B. Harbison are interested.

Alma, Neb.—At a recent special election this town voted in favor of issuing bonds for electric lights and a waterworks system. As soon as the bonds are disposed of the contract will be let for the two plants and work will be commenced this spring.

Berkley Springs, W. Va.—T. H. B. Dawson, Silas J. Honernall, Romanus Hunter, of this place, and others, have incorporated the Berkeley Springs Light & Water Company with a capital of $25,000, to operate a waterworks and electric light system.

Burlington, N. C.—This city will enlarge the electric light plant and install additional engines and dynamos. W. A. Hall, mayor.

Carlisle, Ky.—The citizens' electric light plant was recently destroyed by fire. The loss is about $10,000 with $2,500 insurance.

Creston, Ia.—The organization of an electric light company is proposed. Mayor C. J. Sullivan is at the head of the project.

Dallas, N. C.—The city will petition the Legislature to grant an election for voting on the issuance of $5,000 of bonds to install a system of electric lights. Address the mayor.

Decatur, Ill.—The Consumers' Gas & Electric Company, with a capital of $50,000, has been incorporated by W. M. Bering, Charles S. Needham and others, to manufacture light, heat and power.

Dickson, Tenn.—William McDonough, proprietor of the Dickson Machinery Repair Company, is making arrangements to put in an up-to-date electric light plant whereby he will be enabled to furnish light to business houses and residences.

Far Rockaway, N. Y.—The residents of the Wave Crest section have grown tired of waiting for the city to have lights placed throughout that territory, and now propose to have it lighted by electricity, at their own expense, and a subscription will be raised for this purpose.

Fayetteville, N. C.—The city contemplates enlarging its electric light plant at a cost of $30,000.

Hickman, Ky.—The electric light plant in this city was lately destroyed by fire.

Higbee, Mo.—It is reported that the Higbee Electric Light, Heat & Power Company has engaged W. K. Palmer, C. E., 718 Dwight Building, Kansas City, to prepare plans and supervise the construction of the proposed electric light plant.

Hopkins Station, Mich.—W. F. Nicoll of this place, assisted by experts from Grand Rapids, has made plans to establish an electric light plant here.

Lawrenceburg, Ky.—The Lawrenceburg Electric Light Company has completed its organization with J. M. Johnson, president; E. R. Ripy, vice-president, and Dr. C. A. Leathers, secretary, and will at once arrange for the installation of an electric light plant.

Marion, S. D.—J. A. Heeren and others have been granted a franchise for the installation of an electric lighting system.

Mayfield, Cal.—A company has been organized of local capitalists for the purpose of establishing an electric lighting plant, to furnish light and power for this town and vicinity.

Ness City, Kan.—Milo Heatwole of this city, proprietor of the Roller Mills at Walnut, contemplates installing an electric light plant.

Oxnard, Cal.—This city is to have a new electric light and power plant to cost $100,000.

Plattsmouth, Neb.—The Nebraska Lighting Company has decided to expend $25,000 for improvements in its gas and electric light plant.

Shelbyville, Ill.—The Taylorville Gas Company and the Taylorville Electric Light Company have been consolidated, under the name of the Taylorville Gas & Electric Company. Its capital stock is $127,000. J. N. C. Shumway will be the local manager.

Springfield, Ill.—The Springfield Electric Light & Power Company will expend $20,000 in improvements. New machinery will be installed.

Stillwater, Minn.—The Stillwater Gas & Electric Light Company contemplates installing a new system of street lighting in this city.

Sturgeon, Mo.—The citizens have voted to issue bonds for the purpose of installing an electric light plant.

Urbana, O.—C. H. Marvin has secured a franchise for electric light and hot water heating, and announces that steps will be taken at once for the erection of a modern plant.

Winona, Minn.—Winona County farmers on the roads leading out from Minnesota City to Winona, Fountain City, Rollingstone and to Lewiston, are to be provided with electric light and power, light for illuminating their farm houses, and electric power for driving cream separators, feed mills, etc.

STREET RAILWAYS.

Anderson, Ind.—A trolley will be run from this city to Newcastle through Middletown. It will be built during the summer.

Barberton, O.—The Barberton, Wadsworth & Western Traction Company has been organized with the following officers: President. B. M. Clemdenning; secretary, O. S. Everhard, and others.

Bellefontaine, O.—A movement is on foot for the establishment of a new electric line which will be financed by New York capital.

Decatur, Ala.—L. Watt Allen, of this city, is engaged in securing rights of way for an electric line from Nashville, Tenn., to Huntsville, Ala., and is meeting with success.

Elmira, N. Y.—The Chemung Valley Traction Company will operate an electric railroad 18¼ miles long from this place to Waverly, Tioga County. Its capital stock is $700,000. Directors: E. E. Buchanan, Boyd McDowell and George McCann.

Garfield, Wash.—The Spokane & Inland Electric Railway Company expects to build a line to this city.

Lancaster, Pa.—The Lancaster & Safe Harbor Electric Railway Company has been chartered with a capital of $54,000.

Marion, O.—The Marion Electric Railway, Light & Power Company is planning to install additional engines and boilers in its plant. George Whysell is general manager of the company.

Oklahoma, Okla.—J. S. Robinson, an influential farmer of Council, is authority for the statement that parties recently visited this part of the country interviewing citizens relative to right of way and donations for an interurban electric railway to connect this city and El Reno.

South Haven, Mich.—Mr. Applegate has been granted a franchise to build an electric railroad in this village.

Steubenville, O.—A company has been formed to build an electric railway from this city to Wellsburg, W. Va.

Utica, N. Y.—It is announced that the first steps to equip part of the West Shore Railroad with electricity will be taken in one week. The section on which the first work will be done lies between Frankfort and Herkimer, a distance of about four miles.

Valley City, N. D.—E. T. Bradley will apply for a franchise to operate a trolley line within the city limits.

POWER PLANTS.

Cincinnati, O.—J. V. B. Scarborough has purchased a site and will erect a new power plant.

Fresno, Cal.—The construction of another power plant near the Crane Valley reservoir, having a capacity of 3,500 hp., will shortly be commenced by the San Joaquin Power Company. William G. Kerchoff, of Los Angeles, is president.

Jackson, Mich.—W. A. Foote will erect a new $100,000 power plant.

BIDS WANTED.

Bullock, N. C.—The Royster Manufacturing Company is in the market for a 60 or 75 hp. boiler.

Fulton, Ky.—J. N. Hall, president of the Baptist Publishing Company, of this city, will be in the market for a motor for operating printing machinery.

Gaffney, S. C.—Carroll & Co. want one good second-hand 10 or 12 hp. traction engine.

Memphis, Tenn.—The Pelican Biscuit Company wants prices on electrical equipment.

Newport, Tenn.—The Sanitarium Tablet Company wants prices on electrical equipment.

Pine Bluff, Ark.—The Bluff City Brick Company, of which J. W. O'Neal is manager, 2003 West Fifth avenue, wants prices on engines and boilers.

Richmond, Va.—The Union Trunk & Bag Company wants prices on an engine and boiler.

Savannah, Ga.—The Savannah Lighting Company, Montgomery street, wants prices on outside line material, meters, arc and incandescent lamps, motors, etc.

Sebree, Ky.—J. B. Ramsey, who has secured a franchise to construct and operate an electric light plant here, will be in the market for a boiler.

Shaw, Miss.—J. G. Williams wants prices on a 100 hp. stationary boiler and fixtures.

Sulphur Springs, Tex.—C. R. DeBond is in the market for an engine and boiler.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15¼@15⅜c.; casting, 14⅞@15c.

Attorney Mayer of the Illinois Tunnel Company intimates that the company may expend $100,000,000 on Chicago's undergrond system.

The annual meeting of stockholders of the Western Telephone & Telegraph Company will be held March 21 at 243 Washington street, Jersey City.

The Appellate division of the Supreme Court has dissolved the injunction restraining New York City officials from paying alleged excessive bills to the lighting companies.

The Chicago Telephone Company has declared the regular quarterly dividend of 2½ per cent., payable March 31. Books close March 27 and reopen April 1.

It is stated that there is no truth whatever in the report circulated that there will be an assessment of $5 a share on the stock of the Philadelphia Rapid Transit in June.

The men who have devoted their time and energies to the agitation for lower telephone rates in New York City confidently believe that the legislative committee will make a thorough investigation of the entire telephone question.

President Roosevelt's inaugural address was one of the shortest ever delivered. It contained absolutely nothing disquieting to the financial world. The whole address was idealistic in tone, nothing of a commercial or financial nature being discussed.

Trustees of the Massachusetts Electric Companies now express the opinion that the system as a whole is to-day in better physical condition than it has ever been; that it is well equipped with rolling stock and in position to get the full benefits of increased business.

Sutro Brothers & Co., New York, offer for sale a balance of $1,000,000 New York & Westchester Lighting Company general mortgage 100-year coupon gold bonds at 93 and interest, netting about 4.30 per cent. These bonds are secured by a direct mortgage on the property and franchises of the company.

Notice has been given to the holders of income bonds of the United Railways & Electric Company of Baltimore that a committee has been formed for action looking to the protection of bondholders. Counsel for the committee has advised its members that the terms of the mortgage securing the income bonds do not warrant the non-payment of the coupons, which are now in default.

The publication of the statement of the New York City Railway Company for the quarter ending December 31 and the six months ending on that date, started a lot of talk in the financial district on Saturday on account of some unusual changes as between the September quarter and that ending with December. What attracted the greatest attention was the comparatively small decrease in net earnings in the December quarter as compared with the decrease in the September quarter, and the very great increase in charges in the December period, making a large increase in the deficit for the quarter ending December 31. For the December quarter, the time within which the Subway was opened, the net earnings decreased $31,632 over 1903, and the decrease over 1903 for the six months was but $64,836, leaving $33,204 as the contribution of the September quarter. Apparently, therefore, the opening of the Subway did not have any very marked effect upon the Metropolitan's earnings.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Mar. 4.
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	170¾
Metropolitan Street Railway	123⅝
Metropolitan Securities	84¼
Ninth Avenue	197
Third Avenue	132¾
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	66½
Interborough Rapid Transit	207
New Orleans Railway	4¼
Public Service Corporation (New Jersey)	141
Philadelphia.	
Consolidated Traction of New Jersey	82¼
Philadelphia Traction	101
Union Traction	58⅞
Boston.	
Boston Elevated	156
Massachusetts Electric Companies, com	16½
do. do. do. pref.	57
West End Street, com	98½
do. do. do. pref.	115½
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	11¼
do. do. pref.	51
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	17⅜
do. pref.	66
Electric Boat, com	41
do. do. pref.	82
Electric Lead Reduction	½
Electric Vehicle, com	14½
do. do. pref.	24
Westinghouse, com	181
do. pref.	192
General Electric	188
Boston.	
Edison Electric Illuminating	252
General Electric	187½
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	42¾
do. do. pref.	113¾
Philadelphia.	
Electric Company of America	12⅛
Electric Storage Battery, com	87⅝
do. do. do. pref.	87⅝
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	145½
Western Telephone Company	20½
New England Telephone Company	137
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210¼
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93¾
Chicago Telephone Company	142
MISCELLANEOUS STOCKS.	
Otis Elevator Company	49¾
Consolidated Car Heating	64
Standard Underground Cable	200

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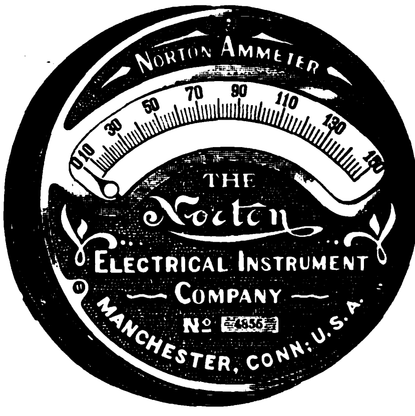
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Norton
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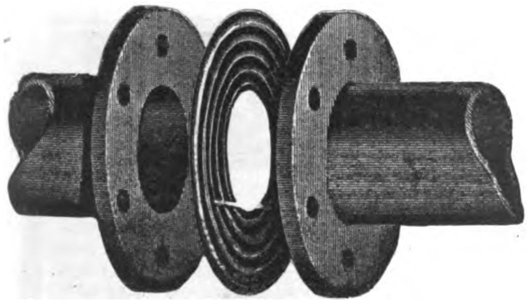
No 4356
MANCHESTER, CONN. U.S.A.



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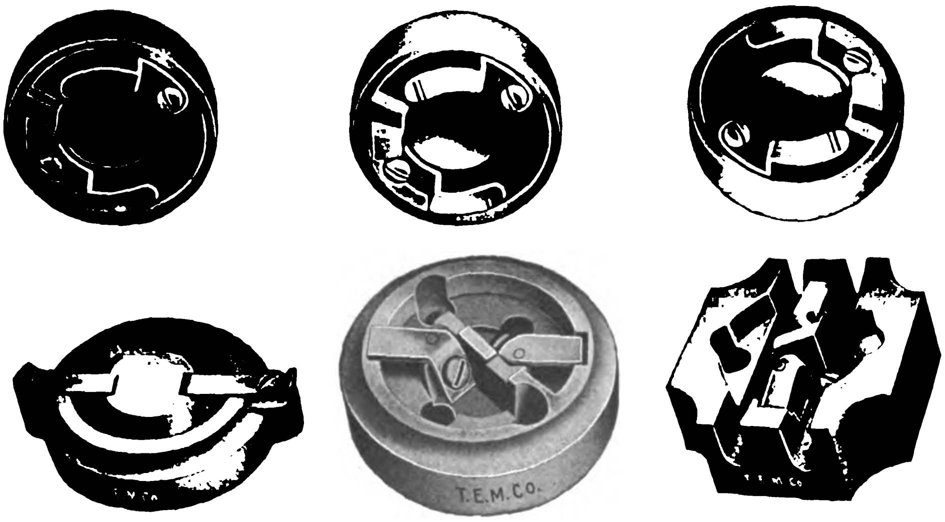

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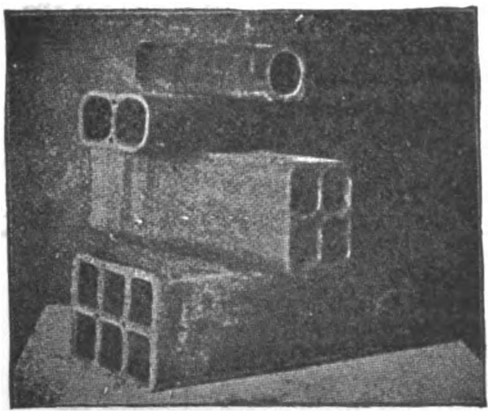

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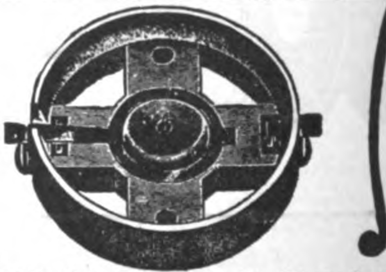

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ELECTRICITY.

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EDITORIAL NOTES.

The Strike. The strike on the elevated and Subway roads in this city, which began at 4 A. M. March 7, is practically over.

The motormen and guards went out because the latter considered they were not receiving adequate compensation for their services.

The Interborough Rapid Transit Company replaced many of the strikers by men imported from Chicago and other Western cities and an attempt was made to operate trains. For the first day or two only a few trains were run at long intervals, and practically no passengers were carried. As a result the surface lines were taxed to the limit and every available carriage and automobile in the city was in demand during the early morning hours. Even then thousands of workers were obliged to walk to their places of business.

The strike, if it did nothing else, has shown New Yorkers in an uncomfortable but forceful way, how much business is dependent on the elevated railway and Subway. Men who heretofore have advocated a 3-cent fare were only too glad to get a carriage at any price to keep important engagements.

A commendable feature of the strike was that the electricians in the power houses refused to go out. These men receive good wages and have responsible positions, and in spite of much pressure being brought to bear could not be induced to leave their posts.

* * *

The Electric Extension of City Suburbs. It is very curious to note the increasing diameter of the zone, which now includes the real activities of Greater New York. The phrase is a most suggestive one, as Greater New York has become since thus designated a greater New York. The electric nerve ganglions, which a decade ago were the sources from which radiated the lines propelling electric cars but a limited distance over the city surface, have been greatly increased both in number and capacity. The Bronx is now as near to City Hall as was formerly the Harlem section, and the city suburbs have been pushed back to the extreme north in the Bronx and beyond Prospect Park in Brooklyn.

The subway will rapidly build up the section now regarded as distinctly suburban and thus the density of population to the north, south, east and west of the original seat of the metropolis will reach a new and perhaps overcrowded maximum. City building in the aggregate is now proportional to the electric railway construction. A copper web has been built over New York from which it really derives its strenuousness. The employer and employe are alike so dependent upon it that its temporary paralysis means the cessation of all industry until repaired. The city zone is an electric zone, the electric car is the maker of enormous dry-goods and amusement centers. Such growth as has been witnessed is in reality the electric extension of the city suburbs.

* * *

What the Electricians Are Earning. The scope and development of electrical industries in the United States during 1904 has been barely understood or appreciated by the busy workers in other fields.

A little illumination on the subject must prove of interest to the technical and general reader and perhaps act as an added stimulus to the beginner. Although the figures given represent gigantic amounts, comparative records show a steady if not a remarkable increase each year in the earnings and profits derived from such enterprises. First in the list as earners come the electric railways, which aggregate the sum of $290,000,000; second in earning capacity are the great manufacturing interests, representing $175,000,000; the electric light companies then appear as third with an earning capacity of $125,000,000; the telephone companies fourth with a record of $110,000,000 and the telegraph companies fifth with earnings of $40,000,000. The total runs very close to *three-quarters of a billion dollars*, and in all probability at the present rapid rate at which various important portions of steam roads are being electrified, large power transmission plants being inaugurated, and a host of smaller electrical enterprises reaching a large and healthy stage of development, a billion dollars will not fall very far short of the great new total.

At the present writing the United States possesses a degree of wealth estimated at 110 billions and many conservative and fair minded statisticians attribute a considerable portion of it to the influence of invention and the application of electricity to industrial purposes. Charles M. Harvey in the "World's Work" states that "Invention and discovery have made the 83,000,000 Americans of 1905 three times as productive as were the 23,000,000 of 1850." The striking statement, which we all realize to be true, is the increased power of each individual as a producer of wealth, through the influences of greater knowledge, by means of which more of our natural resources are turned to profit with a more far reaching economy both as regards time and effort. It seems that this vast organization of forces, internal and external, instituting the present republic, is operating, in spite of its greater responsibilities and burdens with a remarkable national and individual efficiency. It could not be regarded as egotism to claim, that this rising tide of prosperity has never been equalled in the history of any other political aggregation, either as regards its scope or the comparatively short period of its history.

An epidemic of success, is surely a record that can only be interpreted in the light of a unanimity of action and desire on the part of the great producing element of this continent.

The extensive co-operation, the new and exhilarating freedom, the vast range of the educational establishments enlisted in this cause are in the main the essential elements. Practical science, the application of organized knowledge, has won its way to the front. Its garlands of victory have been gained by initiative, perhaps the initiative best shown by a new race of American pioneers among whose names will be found none more honored than Benjamin Franklin, Joseph Henry, Prof. Morse and Alexander Graham Bell.

Could we but trace the correct relationship between cause and effect, not only to-day, but for the not far distant future, it would be found that prophesy will indicate that our national and domestic life is interwoven with electrical discovery; that the larger earnings to which this land will some day point with pride have been made by the electrician, that the loudest and busiest hum from the wheels of industry come from the titanic workshops of these new wizards of progress.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The employes of the Interborough Rapid Transit Company of this city who refused to go on strike will be rewarded with two weeks' extra pay. Some 2,000 employes stuck by the company.

◆

President Davis of the National Electric Light Association has appointed Mr. Arthur Williams to make a report on "Municipal Ownership" to the Denver-Colorado Springs convention.

◆

According to a press report the New York Telephone Company has decided upon an average reduction of 20 per cent. in telephone charges in this city. In return the Merchants' Association must give up its efforts before the Legislature to investigate the telephone company's methods.

◆

A high speed electric line to connect Newark, N. J., and New York by means of one of the tunnels under the North River is contemplated by the Public Service Corporation of New Jersey.

◆

In Connecticut and Massachusetts combined, the New York, New Haven & Hartford Railroad Company now owns about 572 miles of single track electric lines.

◆

A special cable to the New York "Herald," March 11, says: "A practical test of telegraphy by the aid of photography was made a few days ago between Paris and London, which had not the experiment been carried out at the General Post Office would read like a fairy tale of science. The new process, known as the Pollak-Virag system, is capable of turning out the incredible number of 40,000 words an hour. The apparatus works at the rate of 72 letters per second. The details are too intricate to be given shortly, but it may be stated that sensitized paper is used. There are a small reflector and an incandescent lamp, and the writing is done with the point of a fine live wire. It looks like a pencil flame. The exposure is the three-thousandth part of a second and the development and fixing take 5 to 6 seconds each.

◆

Prof. Crew of the Northwestern University, in a paper presented before the electrical section of the Western Society of Engineers, said that "the electron theory, as it stands to-day, is merely a first step toward a more complete description, based strictly upon experimental evidence, and that the ionic hypothesis is the only one which has shown any degree of competency whatever."

◆

Secretary of the Navy Morton has made a contract with the Electric Boat Company for the construction of two submarine torpedo boats, one to cost $250,000 and the other $200,000.

◆

A dispatch from Chicago says the Chicago & Alton Railroad Company has declared war on the electric roads which are paralleling it south of Bloomington, Ill. A schedule which has just gone into effect on the Alton provides for many changes in train service in order to give better facilities for travel than the electric lines. The electric managers are preparing to meet all the steam company's "new ideas" of transportation and go them one better.

◆

The first tax sale in the city of New York since 1899 is advertised to take place on June 14. Included in the list of 122 corporations which are in arrears in taxes are the New York City Railway Company, Manhattan Railway Company and Western Union. A total of $13,200,000 is due the city, and of this amount, Metropolitan and allied corporations owe $2,569,000; Manhattan $1,950,000, and Western Union $18,000.

◆

The city of Montevideo, Uruguay, has contracted for the electrification and extension of the street railways of that place.

◆

The municipal lighting plant of Rock Falls, Ill., is to be discontinued, as it was a losing venture. The city's light will be furnished by a private company.

THE NIEDER-SCHONEWEIDE-SPINDLERSFELD SINGLE-PHASE ELECTRIC RAILWAY.

BY C. SMITH.

The Union Elektricitats Gesellschaft of Berlin has recently installed a single-phase electric railway between Nieder-Schoneweide and Spindlersfeld, Germany, which is of interest in many ways.

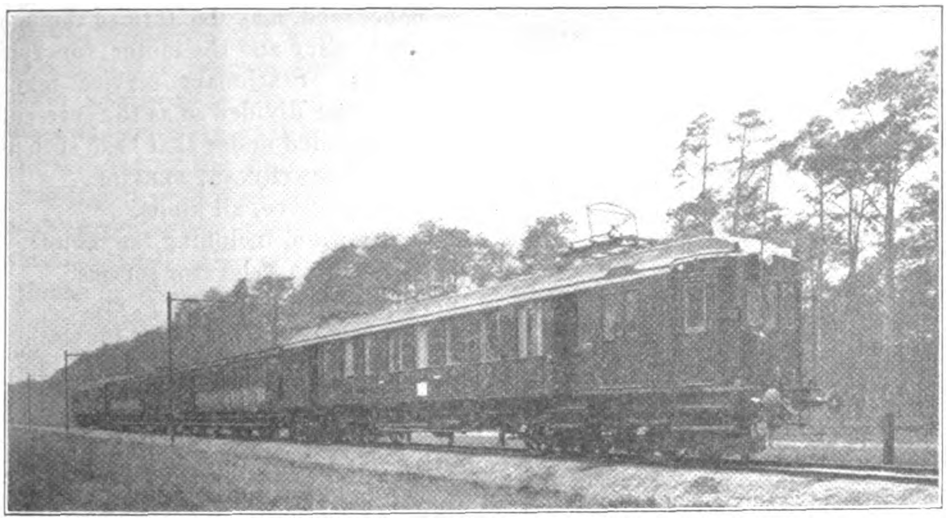


Fig. 1.—Train on the Nieder-Schoneweide-Spindlersfeld Electric Railway.

Trains run every hour during the day, one motor car being utilized for this service, but in the morning and evening a train consisting of two motor cars and three trailers in between is used as seen in Fig. 1. This train weighs about 170 tons and makes an average speed of 34.4 km. per hour.

The line is 4,082 km. long with one intermediate station, Oberspree. The current for this line is generated at Nieder-Schoneweide at a tension of 6,000 volts and a frequency of 25 cycles per second and is conveyed to overhead conductors.

These overhead conductors are supported from longitudinal suspension wires, either one or two such wires being employed for each conductor. In view of the high tension employed the method of double suspension is far safer and better than single suspension although both methods are in use, as can be seen from the accompanying illustrations. Fig. 2 shows the method of single suspension, the line being suspended from side bracket arms, while Fig. 3 shows the use of double bridle wires. It can be seen from drawing, Fig. 4, that the wire is supported freely and yet so as to provide against a failure of one of the suspension wires. Short lengths of wire connect the trolley wire to the bridle wires, which are in turn supported by rubber chains from a bar insulated from the bracket arm. The bar below the bridle wire is connected to the metal pole and thence to the rails. In case of the failure and breakage of one of the suspension wires, it would touch this earthed bar, producing a short circuit and throwing out the circuit breaker protecting the line. It can be seen from this that with the double suspension system great safety is insured.

Telegraph and telephone wires passing over the trolley wire are completely surrounded by a wire cage which keeps them from coming into contact with the high tension line. In passing under the ordinary steel girder road bridges, the insulation must of necessity be perfect, in this case heavy insulators, mounted on a wooden framework, supporting the trolley wire.

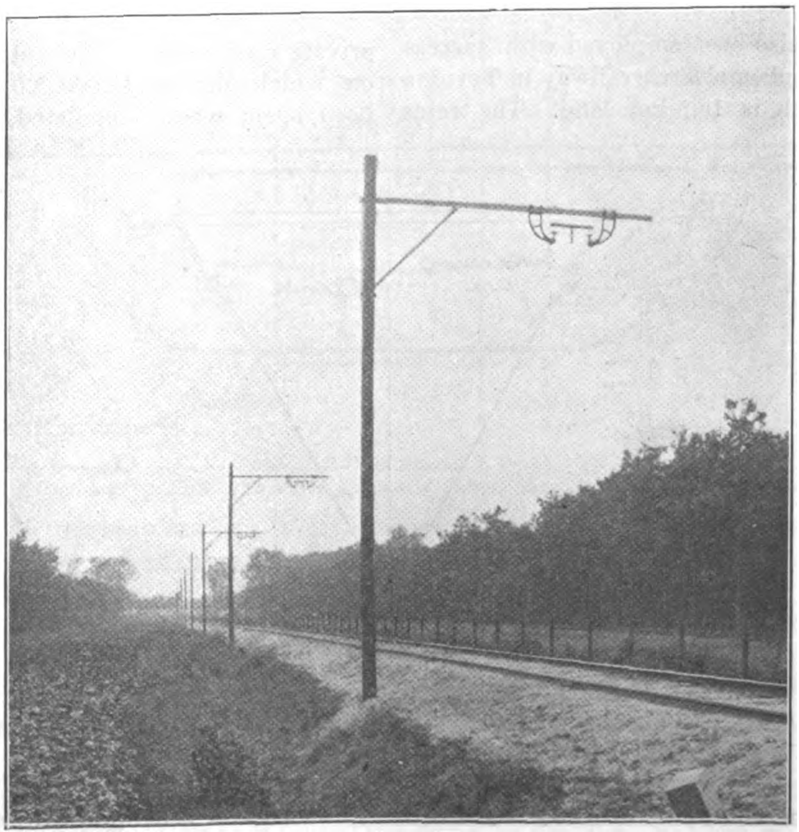


Fig. 2.—Single-Wire Suspension.

The cars are each provided with two motors whose power is rated at 100 to 120 hp. each. The two motors are mounted on the same truck and fitted with single reduction gearing whose ratio is 1 to 4.26. The Winter-Eichberg repulsion-series motor is used, and consists of a rotor and fixed stator. The rotor has a commutator and two pairs of brushes, the second of which, called the exciting brushes, is displaced 90 degrees from the first pair, which coincide with the axis of the magnetic field and are short-circuited. The exciting brushes are connected to the secondary of a transformer, the primary of which is in series with the high tension stator. The use of a transformer enables a high pressure to be used in the fields while a low pressure can be used in the armature winding.

The handle of the master controller is supplied with a push button which must be kept pressed down by the motorman. In case of accident to the driver or should he let go the handle for any reason, the motor is brought to a standstill and the motor handle will go back to the off position and put on the air brakes.

The master and reversing controllers have but a small current of low voltage and all high tension apparatus is arranged in such a way as to insure the highest degree of safety to the motorman, conductor and passengers. Compressed air is used to raise and lower the trolley from the wire.

The Winter-Eichberg single-phase system has also been employed with success on the Stuben electric railway in Tyrol, a line which is 18.5 km. long. The trains in this case consist of one motor car and two trailers. The tension is 2,500 volts and the frequency 42 cycles per second.

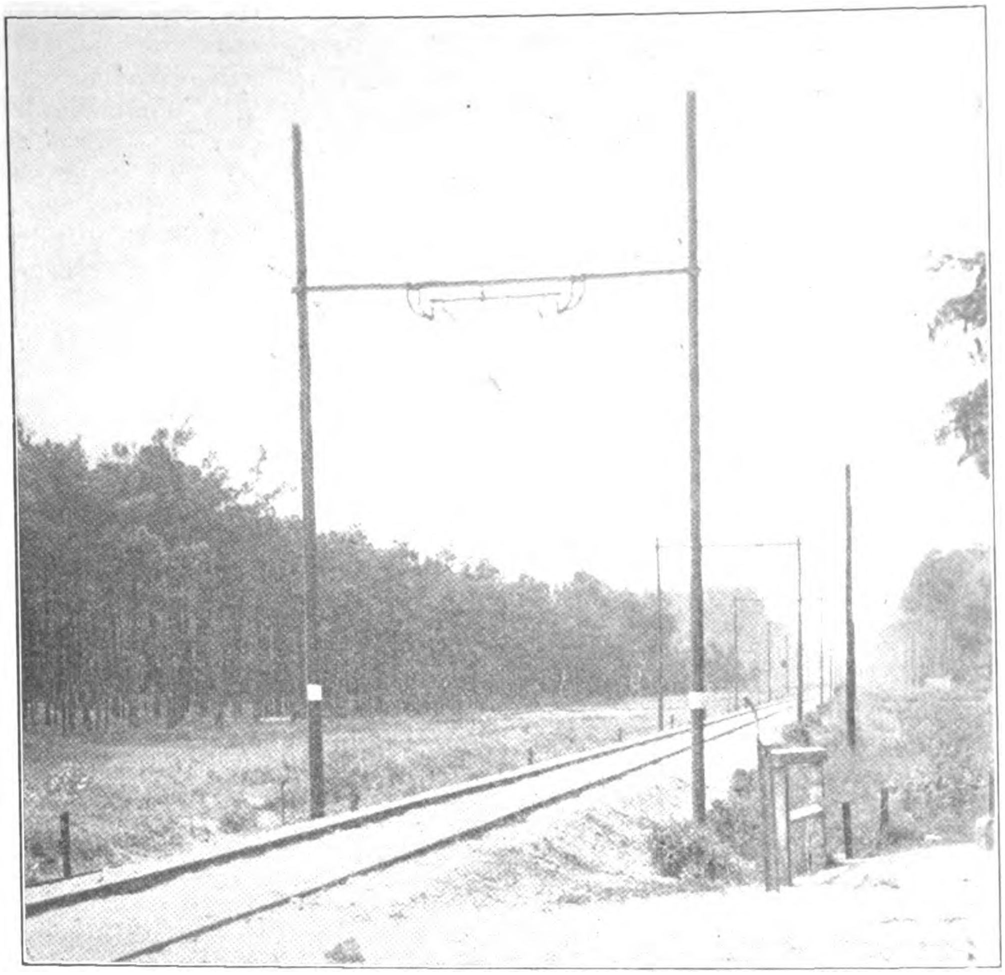


Fig. 3.—Double Suspension Wire Construction.

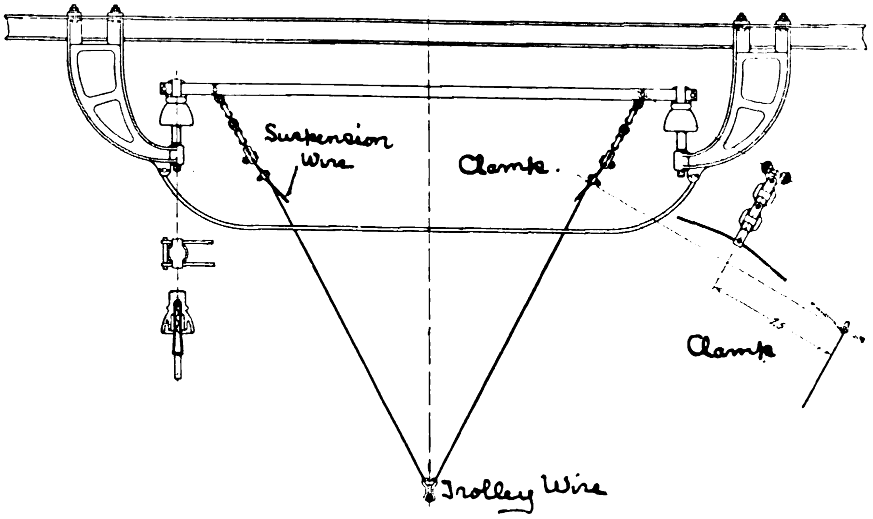


Fig. 4.

Manila's Electric Railway System.

It is announced that the electric railway system in Manila is near completion and that the road will probably be in operation by April 1. About 40 miles of track have been laid and a large electric plant erected, which in addition to supplying motive power for the car lines will also furnish lighting to the city and private consumers. The entire project, on which almost $2,000,000 will have been spent when completed, has been done with American capital, and practically all the equipment and material used is of American manufacture.

Pisa's Wireless Station.

The largest station for receiving and transmitting wireless messages is being erected near Pisa, Italy. On its completion, by the end of the year, it is expected to afford direct communication with all countries of Europe, as well as the United States and Canada, and with all vessels on the Mediterranean, Indian and Atlantic Oceans.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

THE MOTOR.

Conditions of Service.—The two broad classifications of motors, as far as service is concerned, may be termed the motor for stationary and the motor for vehicle purposes. Stationary service may be still further divided so as to represent all those included under that head such as

STATIONARY SERVICE.

Factory drive, all kinds.
Ventilation, including fan motors.
Hoisting and elevator service.
Mining, such as drilling, etc.

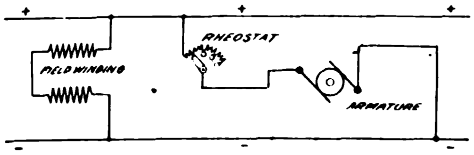
The conditions of service for stationary motors may be extended so as to include applications of less importance, such as dental apparatus, medical appliances, stage devices, etc. The other list of conditions of service, in which the motor is employed for transportation from point to point is as follows:

TRANSPORTATION SERVICE.

Electric railway work.
Automobile work.
Launch work.
Agricultural work.
Mining work.

Depending upon the nature of the application of the motor to any specific purpose, the character of the motor itself is determined. This is the influence which gives rise to the employment of series, shunt or differentially wound machines taking a direct current or the installation of motors taking an alternating current.

Starting a Motor.—To start a motor from a condition of rest requires the employment of a device which will not permit more than the proper quota of current to pass through. In a series motor a resistance interposed between the line and itself will prove sufficient. In a shunt motor it is necessary to take certain precautions in this direction, so as to limit the flow of current through the armature. Enough time must elapse from the moment the current is turned on until the resistance is cut out, to permit the armature to develop sufficient back electro-motive force to act as a restraining influence upon the current. The correct function, therefore, of the resistance is to act as a substitute for the back EMF. It must be remembered that the field windings of a shunt motor are connected across the line and take their energy directly from the circuit. The armature will be connected in the same way *after* the motor is running. But until the motor is developing enough back EMF., a resistance is kept in series with it,



Before Motor is up to speed, Starting Box and Armature in Series.

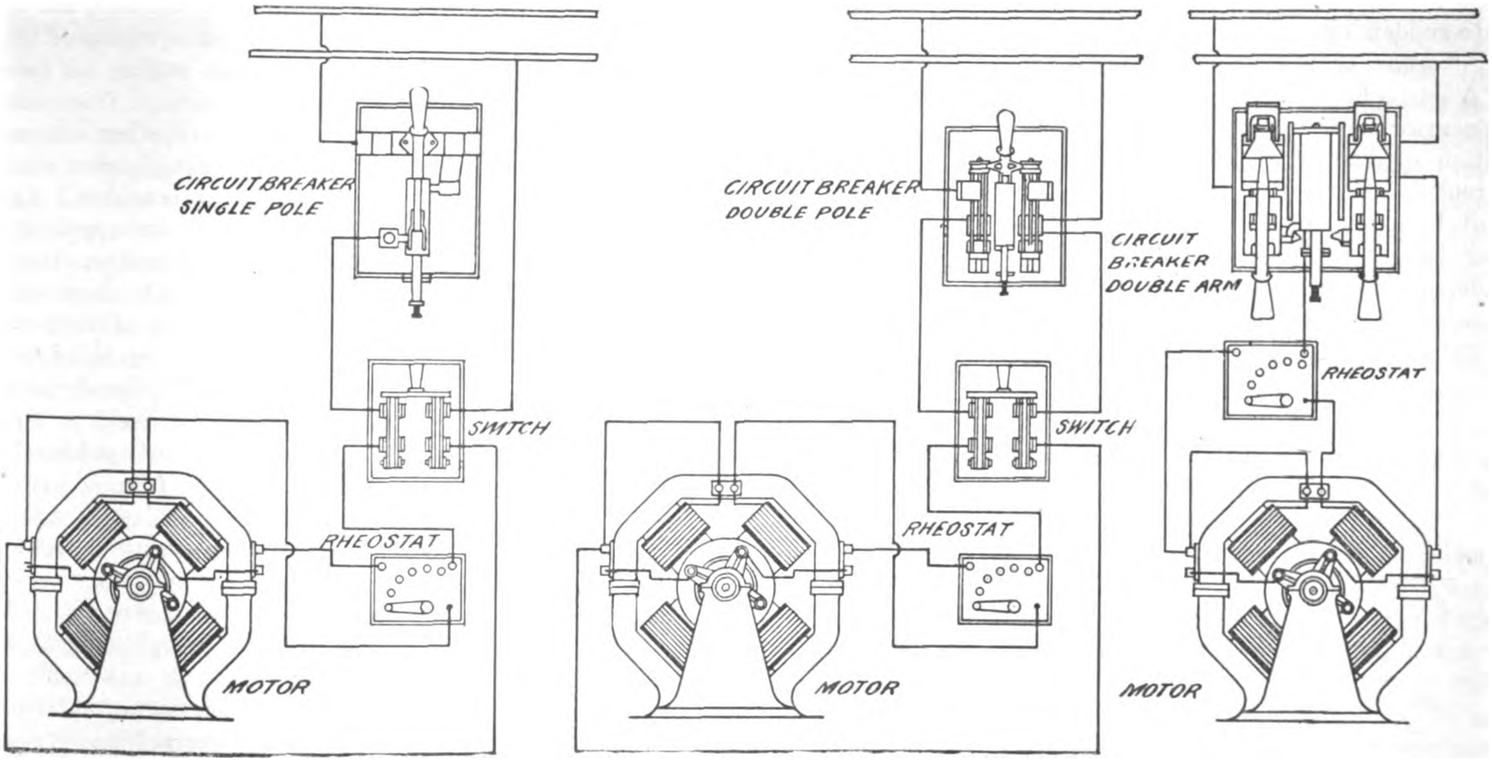
that is, the armature; and only when the speed is high is it deemed safe to gradually cut it out. It is thus evident that both field and armature are in multiple with the line receiving the full pressure, but the armature is protected from an overplus of current when starting, by a resistance in series. The resistance must, therefore, be estimated with respect to these conditions. Suppose, for instance, that an armature of .02 of an ohm is to be put in series with a resistance. A 110 volt current would tend to send in 110 ÷ .02 = 5,500 amperes, which would spell ruination to the machine if such an immense current could enter. Aside from the protective devices employed to prevent just such a catastrophe to the motor, the resistance inserted must bear a definite relationship to the capacity or horse power. Resistances are therefore termed 110 volt 2 hp. resistance boxes or rheostats, or as they are frequently called, "starting boxes." Now in the case under consideration, if the back EMF. of the motor equals 109 volts, the pressure of 1 volt will operate on an armature resistance of .02 ohms, sending through 50 amperes at full load.

If a resistance box of from 10 to 20 ohms is selected, to put in circuit with the armature, then, even though the armature does not revolve very fast only 5 or 10 amperes can get through in the beginning, and the danger of a short circuit is removed. After the armature speeds up, however, the resistance is cut out, the back EMF. bringing about the proper adjustment between the load and the current consumption. The resistance of the starting box is determined, therefore, with respect to the total current the motor will take; its horse power in fact, and it is made adequate enough to limit the flow. It is best to understand that the current a motor takes is largely, if not entirely, a question of its efficiency. For instance, a 10 hp. motor will take a theoretical current of 74.6. amperes at 100 volts pressure. The total watts are 10 × 746 = 7,460; but if the efficiency of the motor is not high, it will take more watts in proportion, which at the line pressure would mean more current. The amount of current required by a series of motors of 10 hp. apiece at varying efficiencies is given below:

Volts.	Horse power	Efficiency.	Total watts consumed.	Amperes.
220	10	100 %	7,460	34.0
"	"	90 "	8,289	37.7
"	"	80 "	9,325	42.4
"	"	70 "	10,657	48.4
"	"	60 "	12,433	56.5
"	"	50 "	14,920	68.0

This table is exceedingly instructive in showing the relationship between efficiency and the consumption of power. It is not difficult to estimate that a motor of low efficiency, will waste in a certain period of time, an amount of power, the cost of which will compare readily with its own cost. In other words, if a motor is cheap because its construction makes it inefficient, it is for that very reason dear, because its power consumption makes it expensive. If a motor costing $100, wastes $10 worth of power a year, in 10 years it eats up its own cost. If it wastes $20 worth a year, 5 years will eat up its own cost, etc. A high efficiency motor is therefore cheapest, though its first cost may be greater. Another point of great interest is that of speed. Small power users are peculiarly addicted to the habit of overloading motors. Jacobi many years ago enunciated the principle that a motor is doing its maximum work, when its speed is one-half its normal speed through being loaded down. At this rate of speed and load, it has only 50 per cent. efficiency. It is therefore consuming twice as much power as it should, and the cost of operation is doubled. While this is true, that a motor can do more work if overloaded, it does that extra work beyond its capacity on a very wasteful basis.

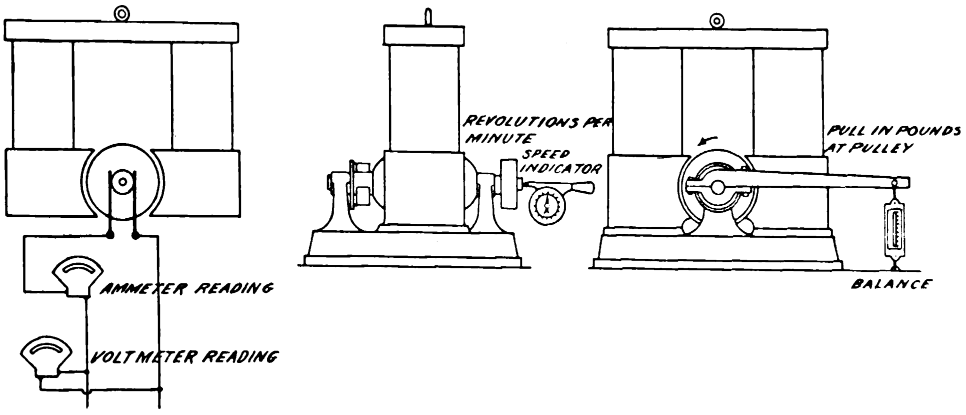
It is not wise, therefore, to place a strain beyond the normal rating upon any motor, unless it be for the purpose of bridging over an emergency for a short period of time. Speed, back EMF., load and line pressure are so related, that they all contribute to the common result of high or low efficiency.


CIRCUIT BREAKER SINGLE POLE
SWITCH
RHEOSTAT
MOTOR
CIRCUIT BREAKER DOUBLE POLE
SWITCH
RHEOSTAT
MOTOR
CIRCUIT BREAKER DOUBLE ARM
RHEOSTAT
MOTOR

Protection of Motors with Single and Double Pole Circuit Breakers.

Circuit Breakers in Motor Service.—The possibilities of sudden overload with the resulting inrush of current have been the means of introducing the circuit breaker, or electro-magnetic switch for the protection of motor as well as dynamo lines. The electro-magnet, and switch, of which it is composed, are simple enough in general construction, but the electro-magnet must be sensitive to a certain value of current; so that if this point is passed it will be the means by which the switch flies open and disconnects the motor from the line. The switch is so constructed that when it flies open its action is sudden and arc-less. The circuit breaker is a substitute for the old time fuse, whose dangerous volatilization was an ever present risk of fire during a temporary short circuit. Motor and dynamo circuits protected with this particular device are like boilers supplied with safety valves weighted to a certain number of pounds. In one case steam pressure will set the valve into sudden operation, in the other case an overflow of current.

A line connecting to either a motor or generator may be protected by the installation of a single pole or a double pole circuit breaker. By this is meant a circuit breaker, which is inserted in only one leg of the line involving a single pole, or one engaging both wires or poles, hence the title double pole.



Readings of an Electrical and Mechanical nature to make a Commercial Efficiency Test of a Motor.

Rating of Circuit Breakers.—In order to convey some idea of the development that has taken place in this particular department of electrical manufacturing, the following table of rating and calibration is given for circuit breakers of from 5 to 1,500 amperes They are of a standard market type, double pole, for from 250 volts or less, and one type so constructed that if during the short circuit or overload of the motor which originally operated the circuit breaker, an attempt is made to close the circuit again, only one pole at a time can be closed. If one has been closed and the other is then set, the first will fly open independently, thus freeing the line and protecting the operator from injurious flashes:

Low Load.		Heavy Load.	
Normal Rating.	Calibration.	Normal Rating.	Calibration.
5	4 to 8	200	150 to 300
10	8 " 15	300	225 " 450
20	15 " 30	400	300 " 600
30	25 " 45	500	375 " 750
45	35 " 70	600	450 " 900
60	45 " 90	800	600 " 1200
80	60 " 120	1,000	800 " 1500
100	75 " 150	1,250	900 " 1800
150	110 " 225	1,500	1200 " 2250
200	150 " 300		
300	225 " 450		

Commercial Efficiency.—The rating of motors for commercial efficiency is based upon the tests to which they are subjected. The tests are simple in character and may be defined as a method of establishing the ratio between the power taken out in a mechanical form to the power sent in, in an electrical form:

$$\text{Commercial efficiency} = \frac{\text{mechanical energy obtained}}{\text{electrical energy supplied}}$$

The motor is supplied with an ammeter and voltmeter to measure the electrical energy sent in. A tachometer or speed meter is utilized for getting the number of rotations of the armature per minute. A dynamometer or brake is used for measuring the pull on the pulley or shaft of the motor. If the pull on the dynamometer or brake is taken at a certain rate of speed, it will be accompanied by a certain current consumption, the voltage remaining the same. This data is serviceable for determining the efficiency as follows:

$$\text{Mechanical hp.} = \frac{\text{Pull in pounds} \times \text{length of brake arm in feet} \times \text{speed per minute}}{33{,}000}$$

$$\text{Electrical hp.} = \frac{\text{Amperes} \times \text{volts}}{746}$$

$$\text{Efficiency} = \frac{\text{Mechanical hp.}}{\text{Electrical hp.}}$$

The efficiency is obtained in this manner for all such points of load as running idle, quarter load, half load, three-quarter load and full load. The speed, amperes and pull will vary in each case, the amperes and pull naturally very much more than the speed, which should not indicate serious changes.

PATTERN MAKING.*

BY R. WATSON.

Twenty or thirty years ago pattern making and mill wrighting were considered joint branches of engineering, but gradually as competition and more complicated work came along, it was found that a man, to become thoroughly efficient, must devote his whole time to one branch. This subdivision has again taken place in the pattern shop of recent years. Iron pattern making has become quite a separate section. This includes the fitting up of iron patterns, turnover plates, and all stripping plates, etc., required for moulding machines. Again, where moulding machines are used men are kept on the special patterns that are required for them until they become quite experts at this class of work.

It is not the writer's intention to deal with these special kinds of patterns; each is important enough in itself to form a separate paper, but to confine himself to his actual experience of wood patterns. It may be well to consider the material used in pattern making. Timber merchants have at various times advised several different kinds of wood, such as kauri pine, American white wood, teak and jarrah, etc., but experience has proved that they are not as suitable for pattern construction as Canadian pine and the mild straight-grained mahogany of Tabasco and Belize. Timber for standard patterns should be carefully selected as there is a considerable variation in the quality of yellow pine. It is not unusual to find a shipment of pine altogether unsuitable for pattern making. It may be free from shakes and knots but has the defect of being hard in places, which is known to the pattern maker as being "strong."

The circular saw, band saw, planing machine, thickness planer and lathes are indispensable tools. The hand trimmer might also be classed among them, for it

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*Abstract of paper read before the Rugby (Eng.) Engineering Society, Jan. 5, 1905.

considerably cheapens the production of patterns, especially of that class which are built up in segments. The introduction of pneumatic tools into the pattern shop is among the latest labor-saving devices. Portable drills and chipping hammers are finding a useful place on large work; they have this advantage, that they can be brought right on the work during the different stages of construction when it would be impossible to move the work to the different machines. Chipping hammers fitted with a gouge tool are very handy for removing surplus wood to form curved surfaces in patterns and core boxes, doing the work from four to six times faster than is possible with hand tools. Pneumatic drills also dispense with the pattern maker's brace and bit and perform the work very rapidly and with considerably less labor to the man.

It is in the pattern shop that the engineer and draughtsman first see the actual thing which they have designed. Many views and sections may be given, but there still remain points which have to be left to the judgment of the pattern maker, such as the development of curves, rounded edges, fillets, etc., all of which go to make the symmetry of the whole. Upon receiving a drawing in the pattern shop, if the work is at all complicated, it is set out full size, but in some cases sections only that are required for the construction of the pattern and arrangement of cores. Machining allowances are shown. All the setting out is done to a contraction rule, so that any dimension may be taken as the pattern size.

In some works the foreman or leading hand sets the work out. The writer prefers that each pattern maker should set out his own work, as by so doing he makes himself familiar with all the details. He is then in a position to discuss the construction of the pattern, method of moulding, and arrangement of cores. It is usual for the principle dimensions to be checked by the foreman. The first thing that has to be determined is the best way of moulding, and if it is likely to be a permanent or temporary pattern. The chief things that govern the moulding are the principal machined surfaces; these are placed in the bottom of the mould to insure them being clean and free from defects. If it has to be machined all over, or top and bottom, extra machining should be allowed on the top side.

Patterns should in all cases where possible be parted and doweled together on the joint line of the mould, as in the case of a cylinder through the center line of the circle, so that when the top part of the moulding box is lifted off, the portion of the pattern covered by it is taken with it. Then the moulder can loosen each part separately and see what he is doing in drawing the pattern from the mould. It is advisable to lift the pattern from the mould rather than the mould from the pattern. If the moulding box has to be lifted off, leaving the pattern behind, it often results in some portion of the mould breaking down, which sometimes costs a large amount of time to repair.

Loose pieces, such as bosses and facings, although objectionable, cannot in all cases be avoided On permanent patterns these should be fixed on by a dovetail. On temporary patterns a screw or wire pin will do, providing the position of the piece is well scribbed round on the body of the pattern. Where several pieces have to be loose near each other, it is as well to leave one large piece of the pattern loose containing them all, providing there is sufficient room in the mould to allow this being drawn in. Another method of getting over the difficulty of several loose pieces is to put them all together in a core. The objection to this is that in dry sand work it often leaves a mark on the casting if the core cannot be put in green and dried with the mould.

In constructing large patterns wide pieces of timber should be avoided because of the shrinkage and expansion. Frames made of narrow pieces and half lapped together at the corners can often be used with advantage. These are stronger and retain their shape better than large flat pieces. There is also a considerable saving of timber by this method. Patterns made of dry timber will expand when left in the mould for any length of time and contract when stored away. In boarding up large surfaces, open joints, say $\frac{1}{8}$ in. between each joint, should be left. All screw holes should be bored larger than the diameter of the screw to allow free movement when the boards expand or contract.

Where possible the grain of the wood should run in the direction that the pattern is going to be drawn from the mould. As little end grain as possible should be left exposed to the sand. If it cannot be avoided it should be placed so that it is the first portion of the pattern which leaves the mould when it is drawn out. If it is in the bottom of the mould the other way of the grain will shrink and leave the end grain projecting, which will pull a part of the mould up when the pattern is drawn out. This is often the cause of the moulder having to do a considerable amount of sleaking to the mould.

In large patterns, such as bedplates, etc., good provision should be made for rapping and lifting, as it adds considerably to the life of the pattern. In the joint or side of the pattern from which it is going to be lifted from the mould, stout timbers should be put in to receive rapping plates, connected to the bottom of the pattern by struts or stays. Lifting bolts or straps should go through the body of the pattern. In cases where bolts are used there should be a plate let in level with the bottom of the pattern and screwed to receive the bolt. Where this system is practiced it is usual to have all lifting plates screwed one size, then one bolt will do service for several patterns. The screwed end of the bolt should be well tapered off to give it a lead into the bottom plate. The top end should have an eye at least 2 in. in diameter, so that it will receive the hooks which are in general use around this class of work in the foundry. There is a certain amount of suction in lifting a pattern from the mould in addition to the weight of the pattern itself. Then there is the question of taking the pattern backwards and forwards to the pattern stores. If lifting irons can be relied upon, it is better to lift by them than by rope or chain slings, for these generally leave their mark on the pattern. In fact, heavy standard patterns are often more damaged in lifting about than in actual use in the foundry.

The question of taper is often a very debatable subject between the pattern maker and moulder. It is seldom the moulder complains of there being too much, but excess of taper often means more machinery than is necessary. There is no standard rule; each piece of work requires separate consideration. In most cases $\frac{1}{8}$ in. to the foot is found to be sufficient. On castings that have not to be machined it is customary to make the given dimensions half-way down the pattern, so that the pattern at the top of the mould is over the size and at the bottom under the size.

In complicated patterns sometimes pieces are left so that the moulder has to lift a part of the mould away before he can draw the pattern out, or, in other words, make a "drawback." This is an expensive method to the foundry. It can often be overcome by a core print being put on the pattern and a box made to suit. It incurs extra cost in making the pattern; still this fact should not be lost sight of, that it only has to be done once in the pattern shop, but every time a casting is made off the pattern in the foundry. If this extra cost is divided by the number of castings required, it will be readily seen that the "print and core box" is often the cheaper method to produce the casting; for this should be the aim of the combined efforts of both pattern maker and moulder. Where the core method is used great care must be taken that the piece which forms the part of the core matches the mould; if it is possible this piece should be worked on the pattern in its place, then taken off and put into the core box. This will ensure getting a good joint and only a very slight mark on the casting.

Prints that lift vertically should have more taper than other parts of the pattern. In no case should the taper be less than ⅛ in. to the inch. The size of the core is the size of the print near the pattern. In prints where the core comes through the top moulding box for convenience of centering or releasing the core, etc., the size of the print is still kept the right size near the pattern, but tapered larger to give clearance for passing the core down, as shown in Fig. 1. No two prints on a pattern should be the same size, or nearly the same size, or probably the mould will be cored up wrong. In prints that mould horizontally the root should have a slight champher on it, as shown in Fig. 2, as the edge of the mould breaking down when the core is put in. If this is not done the moulder generally takes it off with his trowel each time he makes a mould.

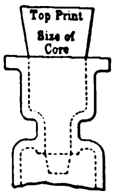

FIG. 1.

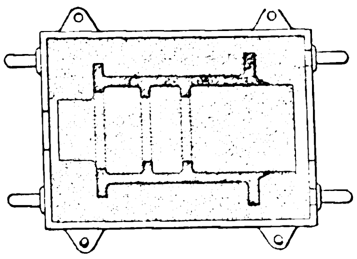

FIG. 2.

Cores are often more difficult than the outside of the pattern; it often takes considerable time to arrange them so that they may be put in the mould in the readiest possible way. Circular core boxes are generally doweled together on the center line for convenience of ramming up and getting the core out of the box. Intricate boxes often have to be made in several parts; where any doubt exists as to the best way of making it, the core maker should be consulted as to the handiest way for him to arrange for his core irons and vent passages. Large sized boxes should be made so that they can be taken to pieces, and the corners rabbeted together so as to insure them being put together in the same place, and not trusting entirely to the screws going in the same holes. In boxes for standard work wood screws should not be used, as the constant taking them in and out wears the holes, and the core is made larger than required. Bolts should be used for screwing the boxes together with suitable shaped handles or wing nuts. These are more quickly released than wood screws and soon saves the extra cost. In no case should the ordinary hexagon nut be used, as the time that should be saved is lost in hunting for a spanner of the right size.

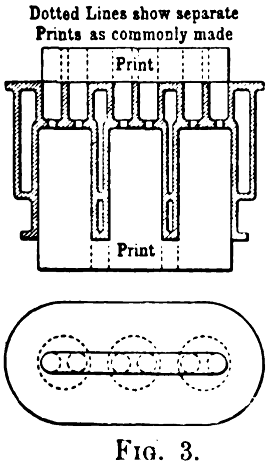

FIG. 3.

In large cores allowance has to be made for the expansion of them in drying; 1-16 in. to the foot is found sufficient if the cores are dried at the usual rate. This point (which is not recognized by some pattern makers and moulders) is often the cause of considerable delay due to the time taken in rubbing the cores down to give the required thickness of metal. After the core has been dried the best test is to try and place it in the box in which it has been made. It is accounted for by the core iron expanding while the core is being dried, and pushing the sand out with it. The core iron contracts in cooling, but the sand on the outside of the iron is baked hard and does not move back with it.

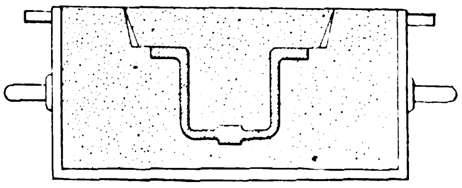

FIG. 4.

Large cores should where possible be made the same way up as they are to be put into the mould, for convenience of getting at the iron to lift them by when fixing.

Where cores have to bore out to exact centers in relation to each other, as in the case of motor cylinders, where two or three boxes are in the same casting, these should be made in one core box tied together by continuous prints at both ends, as shown in Fig. 3. This admits of a good stiff core iron which can readily be broken without any risk of breaking the casting. It is a quick method of coring up, as all the bore cores are put in at one operation, as well as keeping their centers exact, at the same time simplifying the moulding of the pattern.

Where diaphragms, valve facings, etc., on the inside of the casting, have to be put in a particular position in relation to the outside of the casting, a key must be put on the core and its print. This should be put on the joint of the mould where it can be seen when coring up. It is often found useful to make the print on the pattern smaller than the required size of the core, so as to form a shoulder on the core, as shown in Fig. 2. The core can then be put up to the end of the mould; this will give it a definite position lengthways independent of the ends of the print, from which the moulder often finds it convenient to cut the sand away. This shoulder should be made in proportion to the size of the core; it must not be less than ⅜ in., increasing up to 1½ in. in large cores. If it is made too small it will get a thick coat of blacking and do more harm than good. In small cores where great accuracy is required and where the metal is very thin the core should be made about 1-32 in. smaller in size than is required, to allow for blacking, and care must be taken that the cores fit their prints, for when once rubbing is commenced on the core no two castings will be identical. In this class of work the first casting that is made off a pattern should be cut up to see that all parts are of the required thickness.

Core boxes that are made to suit taper prints should be the exact size at the point where the casting commences, but should be slightly less than the top of the print; this will insure them going in easily and tightening themselves when they are down in their right position. Core boards that are to be used for cores of which large quantities are likely to be required should have a thin sheet of iron on the striking edge, filed to the exact shape of the board, on the top side two strips of iron should be screwed on, giving the exact size of the prints into which the core is to fit, otherwise after a few cores have been made the board gets worn and often gives considerable trouble both to the moulder and machinist.

Large work, such as condensers, flywheels, pipes, etc., are usually swept up in loam, very little pattern making being required, as loam boards are used to make both the inside and outside, all projections having to be built in the mould. Work of this type is usually cast upon end. These do not contract the ordinary amount, 1-200 in. to the foot is found to be sufficient to allow in this class of work. Loam work as a rule takes more time in the foundry than when a pattern is used. No doubt it is the correct method to follow when two or three castings only are required, but when this amount is exceeded the cost of a light skeleton pattern, against the extra time each casting will take to make, should be considered. A case of this kind was given in the "American Foundry Journal" some time ago, where an American company had six sets of large engine castings to make, the first one or two of each of the larger pieces were stuck up. Afterwards it was decided to make patterns and moulding boxes to suit. In finishing the remainder it was found to be both cheaper and quicker and the castings better to shape. This question is often settled by the tackle that exists in the foundry, for plates, binders, etc., required for loam work are expensive items. Another way of handling work of which only one or two castings are required is to make the outside in cores. This can often be done very economically, for one or two core-box shells with different internal fittings may be made to do duty for all the cores required. This method cuts the pattern making down to a minimum. In large work of this class especially, the pattern maker and moulder should try to avoid getting into set grooves of working, for the method has yet to be found that is economical and suitable for all work.

Light castings, such as covers, caps, cone pulleys, etc., may be made so that the core takes the place of the top moulding box and is self-centering, as shown in Fig. 4. This core must be at least 1½ in. thick and 1 in. larger all round than the casting, so that it will bear sufficient weight being placed on it to withstand the lift while the mould is being poured. The print should have a large taper; this makes it simpler both for moulding and coring up. It is important in this method of work that the core fits its print, and that no blacking is put on that portion of the core which goes into the print. Patterns of this description, if they are circular, should be built up in segments, or framed up if square.

All circular work on standard patterns larger than about 10 in. diameter should be build up in segments; it has the advantages of being stronger, does not shirk or expand, and retains its shape better than when cut out of the solid wood. The "trimming machines" now used in most pattern shops have cheapened this class of work. Built up work often can be made to leave its own core with advantage, and so save the time and material that would otherwise be spent in making a core box. The writer does not recommend building up flanges, etc., in less than three courses; in fact, two courses are very little better than when cut out of the solid. In pipes, cylinders, etc., "lagging up" is resorted to when the diameter of the work is large, partly to economize material and to secure a form which will be least affected by the distorting influence of shrinkage and expansion. Lags are usually made from 3 in. to 5 in. wide and the number that go to make up a diameter is determined by the size which can be cut most economically out of the width of a plank. In large diameters the rings on which the lags are fixed are built up in segments; this makes a very light but rigid pattern. This method of lagging up is not confined to circular work only, but is used on curves wherever a radial line can be fixed. There is often a difference of opinion as regards the right amount of contraction to allow on special large work, but the writer thinks that most people are fairly well agreed that for general castings 1 in 120 is found to give the most reliable results and most pattern-makers' rules are now made to this allowance. Steel and malleable iron of different makers often vary much in the contraction. In large size castings in these metals the safest way is to ask the founder what contraction should be allowed; on small work the following data can generally be relied upon: General iron $\frac{1}{120}$, loam work cast vertically $\frac{1}{200}$, brass $\frac{1}{64}$, phosphor bronze $\frac{1}{100}$, steel $\frac{1}{48}$, aluminum $\frac{1}{74}$, malleable iron $\frac{1}{64}$ and lead $\frac{1}{48}$.

Painting and Varnishing of Patterns.—Various opinions are held by pattern makers on this subject, but all agree that patterns, except those of the most temporary kind, should be painted or varnished, as it preserves the pattern and fills up the grain of the wood, so that the sand does not cling to it when the pattern is being withdrawn from the mould. One good method that is practiced by some of the larger firms is to paint "black" parts that are not to be machined, "yellow" parts that are machined, and "red" for prints and parts where the core cuts through the metal. In parted patterns the section is painted in the joint. This method enables the moulder to see at once what parts are going to be machined. It also shows him the arrangement of the cores and the thickness of metal, so that he can see where to cut the runner gates to the best advantage, without having to correspond the core boxes with the pattern, thus saving the time which would be taken in doing so. It also assists the pattern storekeeper in getting out the different core boxes belonging to a pattern without having to refer to his book or getting the tracing to see how many core boxes are required.

Upon finishing a pattern all center lines should be cut in deeply with a scriber; this makes it much quicker to check the pattern, and also to make any alterations to it, as most of the principal dimensions are given from the center lines.

Makers of different kinds of machinery have a system of marking their patterns best suited to their own class of work. Standard patterns generally have the marks cast on in raised letters or figures; this mark should also be stamped plainly on the pattern, core boxes, and all loose pieces that are used with it. A method that is now being employed for small patterns is to have the "pattern mark" stamped on a piece of aluminum by an automatic machine; this gives a fairly good mark on the casting if a little extra care is taken by the moulder.

In conclusion, it may be well to add that in making patterns they must not be considered finished articles, but as means which are employed to produce castings. With this aim in view the work should be so distributed between the pattern shop and foundry that upon receipt of an order for castings it will result in their delivery with economical dispatch.

SERIES ALTERNATING ARC LIGHTING.*

BY E. P. WARNER.

(Continued from page 140.)

OUTSIDE CONSTRUCTION DETAILS.

One of the most prolific sources of trouble on outside construction work lies in the lamp suspensions. Where lamps are suspended from span wires crossing the street, it is not uncommon to find a very poor insulator interposed between the lamp and the span wire. This often puts the full strain of the extreme voltage of the system between a lamp and the suspension wire to ground. Heavy leakage and general low line insulation is the result of such construction. In many cases the line loop extending from the pole to the lamp is brought to a small wooden cross-arm equipped with small porcelain knob insulators at each end, and from there extends downward to the terminals of the lamp, which is in turn insulated from the small wooden cross-arm by a single porcelain insulator, the cross-bar itself being practically uninsulated from the span wire when the lamp is hoisted into position. Under these conditions the line insulation is secured only by the small porcelain knobs at the end of the cross-bar and the surface of the cross-bar itself, which in ordinarily stormy weather is entirely insufficient. Under the conditions described the lamp itself is also subjected to severe strain by reason of its insufficient insulation from ground. It is all very well to say that a series alternating arc lamp should be able to withstand a breakdown test to ground without damage to the insulation of 7,000 to 8,000 volts alternating current applied for one minute, but it has been demonstrated in practice that lamps which will stand this breakdown test when new and clean will fall very short of it after but a short period of actual service. The only practical way of securing good line insulation is to place a thoroughly good insulator above the lamp and above the cross-arm, if one is used, so that the line itself, as well as the lamp, will be insulated from the span wire. Under such conditions the necessity for any high voltage test between the live parts of a lamp and the case is done away with and is, in fact, undesirable. No superintendent of a station, who has proper regard for the safety of the lives of his employes, will permit them to handle a live lamp while standing on the ground and no matter what breakdown test a lamp may be said to stand the employe should not place reliance on it, but should as thoroughly insulate himself from ground as though the lamp were alive in all parts.

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* Paper read at the 13th annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 18-20, 1905.

Again, the argument may be raised that there is liability of the lamp coming in contact with some other wire and thus grounding the case. I think there are very few of you who will fail to realize that this is a very remote contingency indeed, and you will also realize that a break-down test such as that outlined above would fall very short of preventing trouble in such a case, particularly after the lamps have been in service for some time.

ARC LAMPS.

In the early stages of development of the different series alternating systems, certain manufacturers attempted to make use of arc lamps in which the regulation was controlled entirely by shunt winding, claiming that by using such a lamp they were enabled to secure very high efficiency with sufficiently good regulation. As time passed on lamps of this type were gradually eliminated from the field, and as an illustration of the survival of the fittest, we have to-day practically only the differential type of lamp, the shunt controlled being a failure.

Now a few words as to the desirable features in the series alternating arc lamp:

1. It must be one in which the operating parts are few and of such design and construction that stock repair parts can be used in repair with facility and dispatch.

2. The parts should be so assembled and attached as to facilitate removal and replacement, also to give ready access for examination and adjustment.

3. All material used should be of a character to best resist the action of the elements and ordinary wear and tear encountered in actual service. The quality of material used and its application should be a matter of careful scrutiny to the station manager, as therein lies part of the secret of reliable and continuous service. Do not let first cost be the prime factor in your choice of a lamp.

4. Regarding the performance of the lamp and the safeguards provided, I would say that it should be capable of regulating the voltage of the arc to the point adjusted within three volts in either direction, and when operated with a current of 7½ amperes should give a life with each trimming of approximately 90 hours.

It is found in practice that variation in the sizes of the carbons, in the character of the core, in the density of the material used in the carbons, will considerably effect the length of life. This means that care should be taken in selecting carbons, though I think no greater amount is necessary than has been found to be the case with old open arc systems. In all lamp mechanisms there is a certain amount of lost energy; in a well constructed lamp this loss should not greatly exceed 20 watts. The efficiency may vary somewhat with the different makes of carbons and the different stages of the burning, but the figures given above are a fair general average. The power factor of an arc lamp varies with the quality of the carbons, with the position of the arc in the globe and also with the character of the cored material. It has been found possible in experimental practice to maintain an alternating arc using two cored carbons of very rich material at unity power factor, but such results have not as yet been obtained commercially. With the ordinary carbons obtainable to-day, a general average power factor of 90 per cent. in the arc can be obtained reliably. In estimating this power factor we find the ratio of ~~the~~ true watts at the arc to the apparent watts. It has not been customary for purchasers to specify any stated performance in respect to the power factor of the arc; they have contented themselves with the power factor of the lamp as a whole. This, of course, is somewhat lower than the power factor of the arc, varying in different makes of lamps. It is, however, a very important feature which must be considered by the purchaser and he should be careful to exact definite performance in this respect.

(To be continued.)

Lehigh University Register.

The Register of Lehigh University, South Bethlehem, Pa., just issued, copies of which may be had on application, shows the attendance of 630 students from 24 States and 8 foreign countries, the largest in the history of the institution. There are 56 in the teaching staff; 92 students are taking the course in electrical engineering.

Thirteen four-year courses of instruction are offered at the University: the Classical Course, the Latin-Scientific Course, the courses in Civil, Mechanical, Marine, Metallurgical, Mining, Electrical, and Chemical Engineering, Analytical Chemistry, Geology, Physics, and Electrometallurgy.

A list of graduates of the University, with their present occupations, 1,399 in number during the 39 years of its existence, indicates that this institution is exerting a marked influence on the industrial development of the United States and of foreign countries.

Provision is made for worthy and needy students whereby they may postpone payment of tuition until after graduation.

Important Catalogue Just Issued.

The 1905 catalogue of the Waterbury Brass Company, Waterbury, Conn., has just come from the printer's hands. We are informed that the catalogue has the complete tables and weights of seamless, drawn, brass and copper tubes and brazed tubes and brass and copper in rod, wire and sheets, also tables which are short cuts in arriving at certain results in figuring inside and outside diameters of seamless tubes for the weights and also in connection with rod, wire and sheet in brass and copper, and a very valuable table of discounts. In connection with this is given a complete list of the stock carried at the Waterbury warehouse and also at the Providence warehouse.

Claim that Chicago Telephone Company is Disobeying the Law.

On the ground that the Chicago Telephone Company is violating its ordinance the city authorities will attempt to compel it to obey the law or drive it out of business. It is claimed that the company by its failure to make semi-annual reports of its receipts, and its practice of collecting tolls in addition to its regular charges in certain districts within the city limits, has forfeited its franchise. Corporation Counsel Tolman has filed a petition with State Attorney Healy asking permission to institute proceedings to test the company's right to continue to operate its lines in the streets of Chicago.

Lectures Before the Society of Engineers of the University of Minnesota.

Mr. Fred. G. Dustin, city electrical inspector for Minneapolis, gave an interesting lecture on February 24 before the Society of Engineers of the University of Minnesota on "Safety in Electrical Installation." After describing the development of the present insurance rules through the co-operation of the electrical and insurance organization he took up the city ordinance governing electrical installation and operation. To illustrate the necessity for certain rules, he showed interesting samples of defective fittings and construction which he had condemned. Samples of new devices showed how new rules are being met. Among other instances of improper operation, he noted an instance where the only fuse in the circuit had been replaced by a tenpenny nail. In closing, he admonished the young engineers to supplement their theoretical work with practical experience, emphasizing that their ultimate success or failure would depend upon their ability to put into practical use the technical training and knowledge they were acquiring.

On March 24, Mr. Benj. Waller, resident engineer of the Northwestern Telephone Exchange Company, will lecture upon "Some Engineering Features of a Modern Telephone Exchange."

New York Electrical Society.

The 249th meeting of the Society will be held at the lecture room of the American Institute, 19 West 44th street, this (Wednesday) evening, March 15, at 8 o'clock. Dr. E. F. Roeber, editor of "Electrochemical and Metallurgical Industry," will lecture on "Recent Developments in the Electrometallurgy of Iron and Steel." The meeting will also be addressed by the well-known authority Dr. Paul L. T. Heroult, of La Praz, France, on "Making and Refining Steel in the Electric Furnace." This subject has been attracting a great deal of attention in the fields of electricity, metallurgy and mining, and the successful solution of the problems involved may revolutionize the iron and steel arts.

Competition for Furnishing Electrical Supplies.

The annual competition for furnishing the executive departments at Washington with electrical supplies during the fiscal year 1906, will take place May 4 next, on which day bids will be opened in all the departments. Specifications and lists of articles required are now being prepared and the call for bids will be issued in ample time to allow prospective bidders to make their calculations.

Custom House Electrical Equipment.

James Knox Taylor, supervising architect, will receive proposals until May 8 for the interior furnishing of the United States Custom House in New York.

PERSONAL MENTION.

Prof. Lucien I. Blake, one of the earliest inventors in submarine signaling, has become associated with the Submarine Signal Company as consulting engineer.

Mr. W. J. Chalmers, vice-president of the Allis-Chalmers Company, has resigned, and it is likely that the headquarters of the concern will now be moved from Chicago to New York. Mr. W. H. Whiteside, former superintendent of the sales department, succeeds to the vice-presidency.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MARCH 7, 1905.

Electric Railways and Appliances.

784,019. Electrically-Operated Station-Indicator. Ernest K. Adams, New York City; Edward Dean Adams executor of said Ernest K. Adams, deceased. Filed March 10, 1904.

784,037. Switch for Overhead Trolley-Tracks. Robert N. Cundall, Hopedale. Mass., assignor to the Draper Company, same place. Filed Jan 4, 1905.

784,038. Automatic Self-Dropping Trolley-Pole. John Delane, Terra Haute, Ind. Filed Sept. 5, 1903.

784,139. Electrical Annunciator for Trolley-Cars. Ira J. Bradshaw, Waukegan, Ill., assignor of one-half to Jacob J. Dietmeyer, same place. Filed June 29, 1904.

784,237-238. Electrical-Rail Guard. Lewis B. Stillwell, Lakewood, N. J., and Frederick R. Slater, Yonkers, N. Y. Filed Sept. 16, 1904.

784,303. Third-Rail Electric-Railway System. Thomas J. Casey and Fred H. Pickles, New York City. Filed Aug. 11, 1904.

784,357. Circuit-Controller for Electric Railway Signals. Harry B. Snell, Jackson, Mich. Filed April 15, 1904.

784,448. Trolley. John H. Thompson, Charleston, W Va., assignor of one-half to Daniel Rogan, Birmingham, Ala. Filed Aug. 4, 1904.

784,522. Railway-Switch. Samuel R. Flowers, Richmond, Ky., assignor of part to William S. Hume and George W. Nelson, same place. Filed May 20, 1904.

Electric Lights and Appliances.

784,071. Electric-Lighting Apparatus for Railway-Cars. Willard F. Richards, Buffalo, and William A. Turbayne, Lancaster, N. Y., assignors, by mesne assignments, to the Gould Coupler Company, New York City. Filed April 4, 1904.

Electrical Machinery and Apparatus.

784,022. Electric Switch. Charles B. Askew, Chicago, Ill. Filed May 11, 1904.

784.032-102. Laminated Core and Brush-Holder for Dynamo-Electric Machines. James Burke, New York City, assignor to the Burke Electric Company. Filed March 9 and May 3, 1904.

784.056. Electric Motor. Waldo A. Layman, St. Louis, Mo. Filed Dec, 28, 1903. Renewed Aug. 25, 1904.

784,064. Electrically-Operated Locking Mechanism. John Nordenberg, Canon City, Col., assignor of one-half to Olof J. Rundahl, same place. Filed Sept. 16, 1904.

784,103. Dynamo-Electric Machine. James Burke, New York City, assignor to the Burke Electric Company. Filed July 18, 1904.

784,308. Electric Motor. George Dengler and Ida W. Schmidt, Detroit, Mich. Filed Sept. 12, 1904.

784,352. Power-Transmitting Device. Samuel W. Rushmore. Plainfield, N. J. Filed April 27, 1904.

784,358. Electric Time-Switch. Stanislaus Stemski, Brooklyn, N. Y. Filed April 12, 1904.

784.387. Electric Meter. Frederick Darlington, Great Barrington, Mass. Filed Oct. 13, 1904.

784,393. Commutator. Gustav Grabosch, Berlin, Germany. Filed July 30, 1904.

784,447. Means for Maintaining Synchronism in Electric Motors. Paul Thomas, Charlottenburg, Germany. Filed March 7, 1903.

784,456. Electromagnet and Armature. Joseph Weber, Brooklyn, N. Y. Filed May 1, 1900. Renewed Aug. 31, 1904.

784,471. Device for Forming Standard Elbows in Electric Conduits or Other Pipes. Lewis H. Church. Stamford, Conn. Filed Nov. 14, 1903.

784,521. Commutator for Electric Machines and Process of Making Same. Fritz A. Feldkamp, Newark, N. J. Filed April 16, 1901.

Telephones and Telephone Apparatus.

784,088. Telephone System. William D. Watkins, San Jose, Cal., assignor to the Watkins Manufacturing Company. Filed March 11, 1902.

784,292. Direct-Line Circuit and Switching Mechanism for Telephone Systems. Albert K. Andriano, San Francisco, Cal., and Hermann Herbstritt, New York City, assignors to the Direct Line General Telephone Company. Filed Nov. 21, 1903. Renewed July 11, 1904.

784,498. Automatic-Telephone-Exchange System. John K. Norstrom and Henry M Graif, Chicago, Ill., assignors to the Automatic Telephone Company, Filed May 18, 1903. Renewed July 5, 1904.

Miscellaneous.

784,024. Dynamo-Electric Massage Instrument. Albert Barrett and William Condon, Kansas City, Mo. Filed July 5, 1904.

784,034. Electroplating Device. George W. Clough, Cleveland, O, Filed Jan. 30, 1904.

784,052. Electromagnetic Device. William Kaisling, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed Oct. 17, 1901.

784,125. Galvanic-Battery Cell. Albert T. Sanden, New York City. Filed Dec. 15, 1904.

784,186. Thermostat. John E. Shepherd, Chicago, Ill, Filed April 25, 1904.

784,226. Electrical Fuse-Primer. Francis M. Quinn, Silverking, Idaho. Filed Sept. 17, 1903.

784,328. System of Electrical Distribution. Frank Hoffman, Chicago, Ill., assignor of one-half to Elmer E. Hanna, same place. Filed May 21, 1903.

784,454. Electric Heater for Oil or Gas Wells. Fred B. Waring, Lima, O., assignor of one-half to Ira R. Longsworth, same place. Filed April 22, 1904.

784,457. Electrical Attachment for Musical Instruments. Josef Weber, Brooklyn, N. Y. Filed Aug. 19, 1904.

784,464. Means for Protecting Electric Cables Against Excess Pressure. Georg Zapf, Cologne-Nippes, Germany. Filed March 24, 1904.

784,502. Magnetic Ore-Separator. Lewis G. Rowand, Camden, N. J., assignor to the Wetherill Separating Company. Filed Feb. 28, 1898.

784,508. Electrically-Actuated Piano. Joseph Weber, Brooklyn, N. Y. Filed Aug. 19, 1904.

784,523. System of Electrical Distribution. Frank Hoffman, Chicago, Ill., assignor of one-half to Elmer E. Hanna, same place. Original application filed May 21, 1903. Divided and the application filed Aug. 13, 1903.

THE TELEPHONE WORLD.

Syracuse Independent Association Organized.

The Syracuse district of the New York State Independent Telephone Association was organized this month with the following officers: Chairman, F. M. Potter, Jr., Syracuse; vice-chairman, F. S. Stockwell, Oswego, and secretary, H. W. Fluhrer, of Auburn. Twenty-five telephone men were present and considerable enthusiasm in the work was shown. The next meeting will be held at Auburn, May 4.

The purpose of the organization was to bring about a closer relationship among the operating systems. The State is divided into 12 districts. Each district will elect a representative to the New York State Independent Telephone Association, and in turn this association will elect delegates to the National Independent Telephone Association.

The Independent companies are strong in the small towns and in the country districts.

Farmers in all parts of the State are considering the advisability of organizing small companies of their own on the co-operative system. The farmers of the town of Van Buren are said to be talking of the advisability of such a plan. In the town of Lysander also there are no telephone connections in the country, and it is believed that a farmers' company could be formed there without serious difficulty.

The Home Telephone Company, of Kansas City, has paid into the city treasury $1,779.01, which represents 2 per cent. of the gross receipts of the company for the three months ending December 31, 1904. During the 10 months the company has been in operation its total gross receipts have been $236,038.84 and the city's share of this sum has been $4,702.77.

It was lately decided at a business men's meeting in Cadillac, Mich., to use the service of the Citizens' Telephone Company, and discard the Bell. The service at Cadillac is being much improved, and a new toll line from there to Harrietta has just been completed. The Citizens' Company now has 755 telephones at Cadillac, and 75 more orders which are being filled, whereas the number of telephones three years ago, when the Citizens' Company entered the field, was but 209, showing the remarkable growth which has been made by the company there.

The Syracuse, N. Y., Telephone Company is still considering extensive improvements for that city, and it is said that the work will be taken up as soon as it can be financed. A large sum of money will be spent, the company claims, and the service greatly improved.

The annual convention of the Ohio Independent Telephone Association will be held in Columbus on March 30.

The sum of $16,244.49 has been paid in dividends by the Valley Telephone Company, of Saginaw, Mich., during the past year.

The Peninsular Telephone Company, of Detroit, Mich., is planning to spend $25,000 in underground construction work.

A 6 per cent. dividend has been declared by the Chippewa County, O., Telephone Company.

New Independent Line to St. Paul.

The West Wisconsin Telephone Company, with headquarters in Glenwood, has arranged to build a line from there through the town of Erie to connect with the Hammond Independent lines, giving connection with all the Independent lines of St. Croix and Pierce Counties. This plan will give a second long distance connection between Glenwood and St. Paul, Minneapolis and all points north as far as Duluth. Work on construction is expected to begin May 1.

The directors of the Heath, Mass., Telephone Company, at a recent meeting, voted to pay a 6 per cent. annual dividend in April—probably by the 10th. On the 15th the stockholders meet to act on a proposed increase of the capital stock, which is now $30,000. The directors favor an increase of $20,000, bringing it up to $50,000. There is an increased business in sight that will keep the company busy with extensions. There is a surplus of $3,700 in the treasury and all the bills paid.

A largely attended meeting of Tuckahoe Neck farmers and business men from Hillsboro and Denton, gathered in the town hall of Ridgely, Caroline County, Md., a short time ago, to discuss the rural telephone system. The company was capitalized at $2,500; 74 shares at 30 a share have been subscribed for the telephone system, which will be known as the Farmers & Merchants' Telephone Company, and it is now an assured fact, and will run from Hillsboro, Denton and Ridgely and the farming community surrounding the towns. George S. Raleigh was elected president of the company.

Over the trunk lines of the United Telephone & Telegraph Company, running between Pottsville, Danville, Shamokin and other points in Pennsylvania, there speed each day between 9 and 3 o'clock both telegraph and telephone messages over the same wires and at the same time. This plan is now proving serviceable in a rush of business.

The annual banquet of the Frankfort Hill Telephone Company was held recently at the home of the President, George Sass, in Frankfort, N. Y. The company is in excellent financial condition, new and important improvements being made and the line is now one of the best local institutions of the kind in the county.

The Keystone Telephone Company's net earnings are reported to be exceeding $30,000 a month. It is said that the friends of the company will take over the $2,400,000 of floating debt.

A. M. Fogg, of East Hebron, Me., will begin in April to establish a local line of telephones in Hancock County, which will extend from Aurora to Ellsworth.

A dividend of 8 per cent. was recently declared by the Beaver Township Telephone Company, of North Lima, O.

A clean profit of $10,000 was made last year by the Valley Telephone Company, of Lebanon, O.

Kinloch Company Will Have a New Exchange.

The Kinloch Telephone Company, of St. Louis, Mo., is preparing to erect a large fire-proof building on the corner of 10th and Locust streets. The new exchange will contain one of the largest switchboards in the world, and all the instruments to be connected will be up-to-date. The style adopted for the design of the building is modern Renaissance. The interior will be constructed with steel columns and floor beams incased and filled in between with re-inforced concrete. The first and second stories and a portion of the basement are to be used for wholesale purposes, and the remaining portion of the basement, together with the third, fourth, fifth and sixth stories, by the telephone company, the operating room occupying the entire sixth floor. No pains or expense will be spared to make a thorough, complete and convenient exchange. Special attention has been given to the heating and ventilation. The entire building will be ready for occupancy the latter part of the year, plans having been completed and the contract let.

The Kinloch Company is a home institution, owned, controlled and operated entirely by St. Louisans. Six years ago the Kinloch Company began operation with 4,000 subscribers. It now has 15,000 telephones in service.

Recently toll connections have been completed by the Kinloch system throughout Missouri, Kansas, Illinois, Kentucky, Ohio, Pennsylvania, West Virginia and nearly all the cities and towns throughout the Central States.

In addition there is through service to such cities as Kansas City, Indianapolis, Louisville, Columbus, Cleveland, Pittsburg, Baltimore and intermediate points, reaching, it is claimed, over 350,000 Independent telephones.

The Missaukee Telephone Company of Lake City, Mich., voted at its annual meeting to declare a dividend of 6 per cent. in addition to the regular 8 per cent. already paid during the year.

The York County, Neb., Independent Telephone Company recently paid its 5 per cent. semi-annual dividend, making a total of 10 per cent. net dividend for the year.

The Citizens' Telephone Company, of Racine, Wis., will shortly offer for sale bonds to the amount of $200,000.

The Citizens' Telephone Company, of Delaware, O., has increased its capital stock from $100,000 to $125,000.

The Citizen's Telephone Company of Montevideo, Minn., has declared a semi-annual dividend of 3 per cent.

Telephone Incorporations.

The New Knoxville Telephone Company, of Auglaize County, Ohio. Capital stock, $8,750. Incorporators: A. H. Steinecker, George W. Hall, F. H. Fledderjohann, George Wellman, E. H. Medstroth and others.

The Greentown Telephone Company, Greentown, Ind. Capital stock, $30,000. Directors: J. M. Glenn, W. L. Bott and Art A. Sargeant.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Alachua, Fla.—An ice plant, electric light and water plant will be built here by T. B. Springfellow, of Jacksonville, and Robert Legueston, of Gainesville.

Bailey, Col.—W. E. Hurd, C. E., is planning to build an electric plant to furnish electric lights for all the resorts from Shawnee to Pine and Buffalo.

Ballard, Wash.—Fred S. Simpson, manager of the Ballard Electric Company, will petition the city council for an electric light franchise.

Bay City, Mich.—The council has granted a franchise to West Bay City for commercial electric lighting here.

Benton, Tenn.—It is announced that L. A. Wyatt will install an electric light and power plant, and has secured the contract for furnishing the city with lights.

Brownsville, Tenn.—This city contemplates installing an electric light and waterworks plant.

Clayville, N. Y.—The Clayville Paper Company will install a plant for furnishing electric lights to this village. The principal office of the company is at Syracuse.

Concord, N. C.—It is reported that this city contemplates issuing $13,000 of bonds for improving the electric light plant. Address Quint E. Smith, city engineer.

Dickinson, N. D.—The electric plant of this city is being enlarged.

Foley, Minn.—Daniel Stimler, of Minneapolis, has applied to this village council for a 20-year franchise for an electric light plant.

Freeport, N. Y.—The Freeport Gas & Electric Company has been incorporated. The capital stock is $1,000, and the directors are Lee W. Wertheimer, of New York City; H. C. Miller, of Tarrytown; Louis A. Klipp, of Brooklyn

Ft. Valley, Ga.—An election to issue bonds to the amount of $12,000 for the erection of an electric light plant here has been carried.

Greenville, Ala.—The C. C. Henderson Electric Light Company has secured a franchise for the establishment of an electric light plant.

Gretna, La.—It is reported that the Algiers, La., Waterworks & Electric Light Company will extend its system so as to furnish this place with electric lights.

Henderson, Tenn.—The Henderson electric light plant has been purchased by Mr. Gullett, of Bells, and will be started soon.

Highland, Wis.—A special election is to be called to vote on bonding the village to raise funds to build an electric lighting plant for this village.

Howell, Mich.—A new 60 hp. engine is to be installed at the waterworks and electric light plant.

Jefferson City, Tenn.—The Jefferson City Electric Light Company will erect a new electric light plant.

Marietta, I. T.—This town has granted to J. B. Hutchins a franchise to erect an electric light plant.

McKinney, Tex.—A Dallas broker has purchased $8,000 worth of this city's electric light bonds.

Mexico, Mo.—The Mexico Electric Light Company has been granted a 20-year franchise.

Niagara Falls, N. Y.—The city council has granted a franchise to the Niagara Falls Hydraulic Power & Manufacturing Company to build conduits for the distribution of electricity for light, heat and power purposes.

Noblesville, Ind.—A 10-year contract for lighting this city has been let to B. W. Hultzmann & Co. The new company is a consolidation of the old electric light company and the Noblesville Hydraulic Company. About $150,000 will be expended in improvements, which include the construction of a new plant.

Prairie Grove, Ark.—C. L. Cummings has proposed to install an electric light plant here.

Rome, Ga.—It is reported that this city will petition the Legislature for authority to construct an electric light plant.

Shelbyville, Tenn.—This city contemplates installing an electric light plant. Address H. L. Wooley.

St. Augustine, Fla.—It is reported that Dr. Littleton, representing others, has applied for a franchise to install an electric lighting plant.

Terre Haute, Ind.—The McCulloch Company of St, Louis, Mo., has been engaged to prepare plans and estimates for the erection of a municipal electric light plant here.

Tulsa, I. T.—The People's Gas Company has been granted a franchise to wire the city for electricity.

Valdosta, Ga.—This city contemplates installing an electric light plant with a capacity of 60 to 100 arc lights. D. G. Griffin, or W. D. Peoples, chairmen of the electric light committee, may be addressed.

Valley Junction, Ia.—The Valley Junction electric light and water plant, has been sold to a private company, composed mostly of local parties.

Waynesfield, O.—W. H. Bailey contemplates establishing an electric light plant here.

STREET RAILWAYS.

Albany, N. Y.—The Interborough Rapid Transit Company of New York has obtained a decision from the Court of Appeals requiring the State Board of Railroad Commissioners to issue to it a certificate authorizing it to construct six new lines in Bronx Borough.

Austin, Tex.—The Houston-Galveston Electric Railway Company, capitalized at $350,000, purposes to build an electric railroad between Galveston and Houston. Incorporated by Frank P. Read, William Johnson and others.

Boone, Pa.—An electric line is to be constructed from this city to Ft. Dodge.

Corry, Pa.—The Corry-Findley, Lake & North East Railway Company was lately incorporated at Albany, N. Y., to operate an electric road 13 miles long in Chautauqua County, on the border line between New York and Pennsylvania. Its capital stock is $130,000. Charles P. Northrup, of Warren, and M. Raymond, of this place, are the incorporators.

Gulfport, Miss.—It has been decided to build an electric road to connect this city with Biloxi. J. T. Jones and W. T. Jones are interested.

Lansing, Mich.—The Lansing & Suburban Traction Company proposes the construction of an electric line from this city to Jackson, if the necessary right of way and franchise can be secured.

Mountain Home, Idaho.—An electric railway is proposed for this city.

New Castle, O.—The city council has been asked by the New Castle Electric Railway Company for a 50-year frenchise.

Pottsville, Pa.—The Tamaqua & Pottsville Electric Railroad Company has been granted a franchise for building two branches through the town of St. Clair.

Watertown, N. Y.—Loomis Allen, of the Utica & Mohawk, has made an inspection of the Rome road from Carthage to Sacketts' Harbor, with a view to equipping that road with electricity between the places named. It is more than probable that the 30-mile stretch will be equipped before the end of summer.

POWER PLANTS.

Blacksburg, Va.—It is reported that plans will be prepared by L. S. Randolph, C. E., of this city, for the proposed power plant to be built at the Western State Hospital, to consist of a duplicate generating plant, and a power and distribution system of motors.

Chicago, Ill.—Sears, Roebuck & Co., of this city, will erect a new power plant at Pullman. The plant will be of 12,000 hp, and will be capable of running 30,000 electric lights.

Spokane, Wash.—The Spokane Traction Company will soon erect a $700,000 power plant at Coeur d' Alene, Idaho. Jap P. Graves is president of the company.

Turtle Creek, Pa.—The Rose Hill Electric Light Company, of this place, has purchased a site for the construction of a new power plant.

Wichita, Kan.—The Citizens' Light, Heat & Power Company, of this city, will soon commence the erection of a new power plant. H. G. Landis is interested.

BIDS WANTED.

Camden, N. J.—Sealed proposals will be received at the city clerk's office until March 20 for lighting the city hall with electric lights. A certified check for $25 is required. C. H. Turner, chairman property committee, city hall.

Chicago, Ill.—Bids will be received until April 12, by S. D. Griffin, clerk of the sanitary district of Chicago, for building the power house of the Lockport Power Development Company, near Lockport.

Little Rock, Ark.—Sealed bids will be received by L. W. Cherry, until March 20, for the installing of steam boilers, engine, pump, etc., in the new Little Rock High School, in accordance with plans prepared by Architect Frank W. Gibb, 2-4 Reider Building, this city, A certified check for $200 is required. L. W. Cherry, chairman building committee.

Mannington, Ky.—The Mannington Coal & Coke Company wants prices on electrical equipment. J. B. Williams, president, Frostburg, Md.

Selma, Ala.—Peacock's Iron Works of this place is in the market for a 50-light dynamo.

Thomasville, Ga.—The Thomasville Chair Company wants prices on engines and boilers.

Wilmington, N. C.—The Southern Electric Company, Old Courthouse Building in this city, is in the market for a marine generating set, consisting of six kilowatt 110 to 125 volt generator, direct-connected to a 10 hp. vertical engine.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15¼@15⅜c.; casting, 14⅞@15c.

The United Traction & Electric Company of New Jersey has declared a dividend of 1¼ per cent., payable April 1.

The Delaware Interurban Railway Company, capital $500,000, has been incorporated to build an electric road in and about Wilmington.

A Philadelphia dispatch says that two parties, well known in financial circles, are seeking to obtain control of Electric Company of America.

The value of the $105,000,000 outstanding traction stocks and bonds issued by Chicago companies is dependent on the result of the municipal election in that city.

The Metropolitan Street Railway Company of New York will pay the regular guaranteed rental of 1¾ per cent. on April 16. Books close March 24 and reopen April 16.

The regular quarterly dividend of 1¾ per cent. on the stock of the Manhattan Railway Company of New York will be paid on April 1. Books close March 17 and reopen March 30.

A special meeting will be held March 16 to increase the capitalization of the North American Company to $30,000,000. The North American Company now has practical control of the lighting and street railway interests of St. Louis.

A big financial transaction has just been completed in Montreal, Canada, whereby certain large holders of stock in the Montreal Light, Heat & Power Company transfer to London capitalists 20,000 shares in that company at the par value of $2,000,000.

The shares of the Interborough Rapid Transit Company of New York on Saturday rose 6½ points to 220½. This is an advance from 203¼, the low price touched on Tuesday of last week, the first day of the Subway-elevated strike. The high record for the stock is 226.

The Philadelphia Rapid Transit Company contemplates beginning a ten-mile subway in Broad street, Philadelphia, about the time the Market street subway and elevated line westward from the Delaware River is finished. The cost is estimated at $1,000,000 a mile.

A cable dispatch from Paris says that Frank Tilford, of the firm of Park & Tilford of New York, has purchased a controlling interest in the Paris Electric Lighting plant for $3,000,000. A later dispatch, however, says the managers of three of the big Paris electrical companies claim there is no truth in the report.

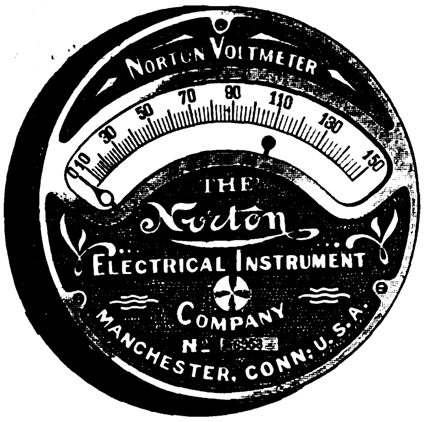
The offer of the New York, New Haven & Hartford Railroad Company to purchase the Hartford Street Railway has been accepted, the compromise figure being $285 cash a share for this stock, and $285 for the East Hartford & Glastonbury Horse Railway Company's debenture bonds. The offer was made to all holders of stock and debentures, and has been accepted by a majority of both.

The report of the Western Union Telegraph Company for the March 31 quarter is very much better than might have been expected, in view of the severe storms which the company was obliged to encounter early in the quarter. The estimated figures just issued for the quarter show a decrease of $137,000 in comparison with the actual figures for the same quarter of last year. As the company is always conservative in its estimates, it is certain that the actual figures will reflect a loss, probably, of not more than $100,000.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Mar. 11
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	171
Metropolitan Street Railway	123¼
Metropolitan Securities	85¼
Ninth Avenue	197
Third Avenue	132¾
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	66⅝
Interborough Rapid Transit	219¼
New Orleans Railway	4¼
Public Service Corporation (New Jersey)	141
Philadelphia.	
Consolidated Traction of New Jersey	82½
Philadelphia Traction	101
Union Traction	58⅞
Boston.	
Boston Elevated	156
Massachusetts Electric Companies, com	19
do. do. do. pref.	65
West End Street, com	97
do. do. do. pref.	116
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	12¼
do. do. pref.	51
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	16½
do. pref.	62
Electric Boat, com	41
do. do. pref.	82
Electric Lead Reduction	½
Electric Vehicle, com	14½
do. do. pref.	24
Westinghouse, com	181
do. pref.	192
General Electric	188
Boston.	
Edison Electric Illuminating	251
General Electric	188
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	43
do. do. pref.	114
Philadelphia.	
Electric Company of America	12⅛
Electric Storage Battery, com	87½
do. do. do. pref.	87½
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	146¼
Western Telephone Company	20½
New England Telephone Company	137
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210¼
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	172¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	94
Chicago Telephone Company	142
MISCELLANEOUS STOCKS.	
Otis Elevator Company	49¾
Consolidated Car Heating	64
Standard Underground Cable	200

NORTON SWITCHBOARD INSTRUMENTS.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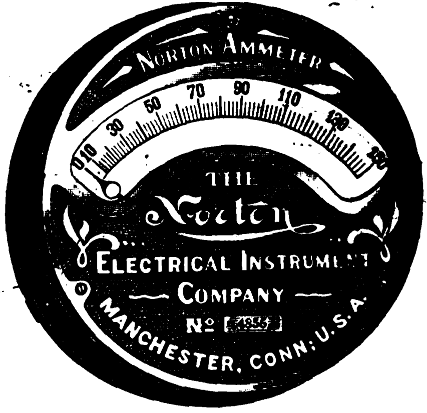
0 to 1500 amperes.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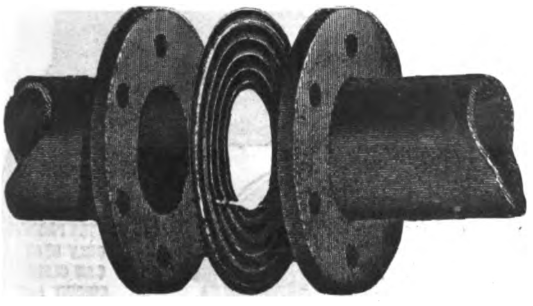

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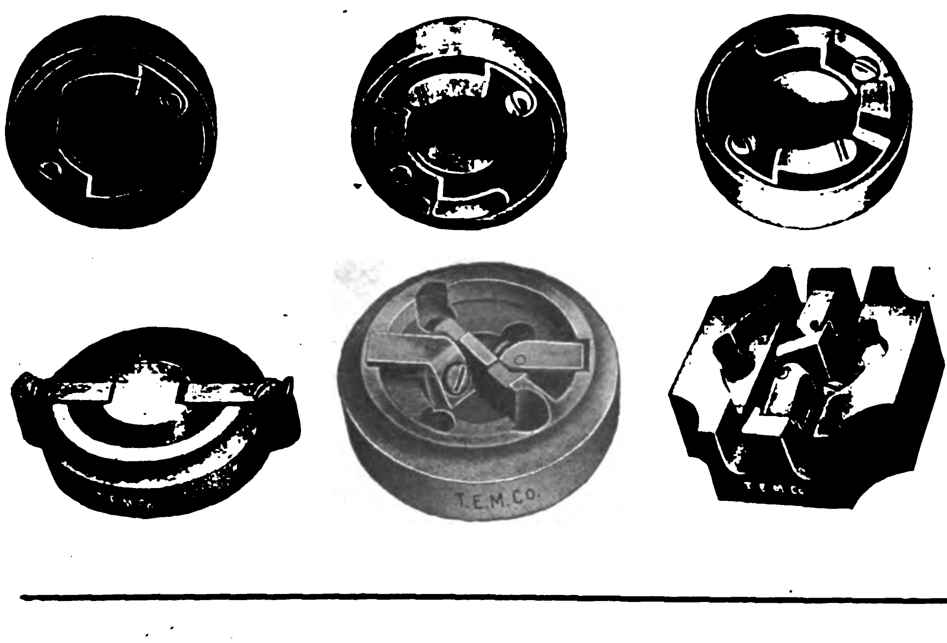
PITTSBURG, PA., 701 Empire Bldg.

THE AULTMAN COMPANY, CANTON, O.



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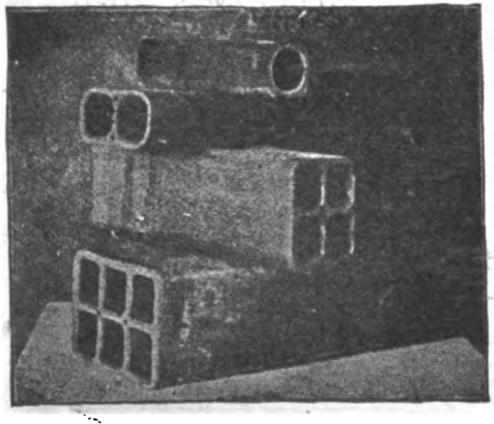

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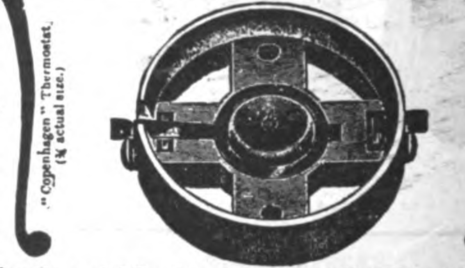

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EDITORIAL NOTES.

The Resources of Alaska

The recent discussion about the present and future status of Alaska as regards its relationship to the United States has been the means of drawing attention to the present and future prospects of that vast region, its limitations and its resources. The most urgent need of Alaska at the present time is adequate railroad facilities. Given these, and there will soon be a rapid development of trade, highly reciprocal in its nature.

While Alaska is a territorial possession of the United States, it has not yet been accorded a territorial form of government. It has now about 26 large cities and towns, not to mention the scattered mining camps throughout the length and breadth of the land. Its natural resources are such that there must be a constantly increasing population, much of it of a permanent character. The area of that country is 329,529,000 acres, of which 272,000,000 acres are in the temperate zone. Thousands of miles of its coast line are warmed by the Japanese currents; all known minerals are found there, some in great quantities.

This being indisputable, it might be interesting to go a little further into its resources, development and commercial possibilities.

The Alaskan telegraph was opened for business over the entire system on August 23, 1903, since which time it has been operated with a reasonable amount of success up to the present time.

During the past fiscal year the line was interrupted 206 times due to snowstorms, blizzards, sleet and ice, high winds, forest fires, etc. The longest interruption occurred during the month of August, 1903, between Tolavena and Chena, covering a period of 18 days, and was due to forest fires.

The lines from Fort Egbert to Valdez, and from Fort Gibbon to Fort St. Michael are in good condition, while the Tanana section is only in fair condition.

The cable offices at Juneau and Skagway were in operation before July 1, 1903, and the cable to Haines Mission was completed and that office opened on July 21, 1903. The cable to Sitka was completed October 2, 1903, and the office opened the same date.

The impossibility of maintaining a cable across Norton Sound, between Fort St. Michael and Safety Harbor, due to a destructive action of the ice in the spring, led to an attempt to communication by wireless telegraph, and this was put into effective operation about August 1, 1904.

Cable communication has also been established between Sitka and Seattle, and work is now being carried on between Valdez and Sitka.

A great degree of satisfaction is expressed by those in authority over the work of the Signal Corps in extending telegraphic communication with Puget Sound. When the part between Sitka and Valdez shall have been completed we shall have an all-American route for communication and feel in a great measure independent. The immense value of this to the Government in governing the territory can hardly be overestimated, and it is felt that Congress has been fully justified in going to the necessary expense entailed by its construction.

Another element of importance in connection with our Alaskan possession, is its immense possibilities of supplying our demands for copper. The mine at Ellamar, Prince William Sound, has produced 20,000 tons of ore, which were shipped to the smelter at Tacoma, Wash. Shipments of this ore from La Touche Island in the same sound have begun. A number of other properties in this locality are under process of development. Among these may be mentioned the Boulder Day group of the Reynolds-Alaska Development Company. Development work was carried on upon the great ore bodies along the Chityna and its branches, especially upon the Elliott, Hubbard and the Bonanza group. These mines cannot be profitably utilized until there is a railroad built to them. The copper ore deposits upon Prince of Wales Island have recently been undergoing development. Ore from one claim is being shipped to a smelter in British Columbia. A smelter of large capacity is under construction at Hadley, and another at Copper Mountain. There can be no doubt as to what Alaska will do in the near future in the way of copper production. Cheap water transportation favors the mines along the coast, and the riches of the ore there and in the interior, favors its being worked at a profit.

The returns for the past fiscal year show that the shipments of equipment for electric railways from the United States to Alaska reached a value of $1,661; 7,473 pounds of copper in bars, ingots, etc., at a value of $2,134; and of all other manufactures of copper to a value of $3,934; while of electrical appliances, including telegraph and telephone instruments, the total value of the shipments reached the sum of $50,702. That of electrical machinery is reported as being $22,351. Our receipts of copper ore during the year, amounted to 5,745 tons at a value of $137,703; while of manufactured copper the value was $4,897. Recent surveys that have been made show that there is practically an unlimited field of copper in Alaska to be developed.

* * *

Why the Coal Consumption is so Heavy.

Statisticians provide estimates which sometimes defy criticism. They indicate with almost barometric precision the drift of industrial development and clearly show the tendencies of the times with regard to the greater causes of human effort. That which we call the products of manufacture are classified and rated with the result that we know how much machinery is being made. We are made familiar with the extent to which all articles of general use are produced and are thus able to know where the wheels are turning fastest and longest. The records of the nations' demand for foodstuffs are kept as shown by the statistical sales of cereals, and the degree of consumption in other directions, covering a vast list of utilities and domestic articles, supplies as it were the true scheme of national progress. This at least is the outward appearance of things; the reasons for increased consumption here or there are at times lost to sight. But behind all this activity, perhaps lying at the very foundation of it, is quite another reason. The statistician has silently pointed it out and it speaks with dramatic force to those whose education, sensibilities and training are responsive to it. It is the record of our coal consumption, which has risen from 33 million tons in 1870 to the enormous figures of 319 million tons in 1903. It might be said by some that we export a great deal of this fuel, but this is not so; the exportation does not exceed 3 per cent of the total. In other words, we burn nearly 40 per cent. of the coal of the entire world. The people of Great Britain, Germany, France, Austria and Hungary, including ourselves, last year mined and practically consumed 864 millions of tons.

What relation 319 millions bears to 864 millions it is easy to perceive. If we are burning so much coal, what is it being used for? In what department of the arts and industries or domestic life do we find a necessity arise for so great a consumption? It is evident that in general the greatest coal consumption is required for the home and hearth of a myriad of American domiciles; then come the steel and iron foundries, the busy factories, the great steam roads and finally the electric light and power plants. In this last respect the United States knows no second place. What part of the 40 per cent. of the 864 million tons can be regarded as productive of electricity for light, power and traction? It has been estimated that one billion dollars represent the earnings from electrical enterprises of all characters in the United States. If this is so, then as a large part of these earnings are derived from street railways and electric light and power plants, it can be safely concluded that at least 10 per cent. of the world's coal consumption is through these causes. The increasing use of electricity for purposes whose name is legion, means the increasing use of coal. Electricity, then, threatens to become the form of power whose increasing consumption of coal will affect the statistician's record. If the question were asked to-day "Why is the coal consumption so heavy?" some doubt would be expressed as to the correct answer. When a decade has passed, however, and the great changes have occurred which mean the use of electricity as a national commodity, a more definite answer can be given to this question and it will be framed in those letters which spell the word electricity.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

At the International Railway Congress, to be held at Washington, D. C., from May 3 to 13, several interesting papers on electrical subjects will be read.

◆

Marconi says that he has perfected a receiver which will permit the transmission of 100 words a minute.

◆

Prof. F. A. C. Perrine has gone to Mexico on an important hydro-electric project.

◆

We are informed that a hurried canvass of the different cities which will be represented at the coming convention of the National Electric Light Association shows that the attendance will be greater than had been expected. Several special trains from Eastern cities have been engaged by delegates, and a number of large parties are being organized to make the trip.

◆

The Armours of Chicago are becoming the greatest owners of municipal utility plants in the West. They control the railroad and lighting business in Kansas City, the City Railway of St. Joseph and are reputed to be the largest owners in the Omaha-Council Bluffs City Railway. The deal they are now reported working on in Des Moines is said to represent nearly $12,000,000.

◆

Prof. L. C. Herdt, assistant professor of electrical engineering at McGill University, Montreal, has been awarded the honorary title of officer d'academie, by the French Government, for services rendered in the field of art, science and literature.

◆

The Roman Tramways Omnibus Company of Rome, Italy, is shortly to adopt electricity on its roads. The first section to be constructed will be the line between the Piazza del Popolo and Ponte Milvio. The Leghorn Tramways Company will also construct a system of electric railways in Leghorn.

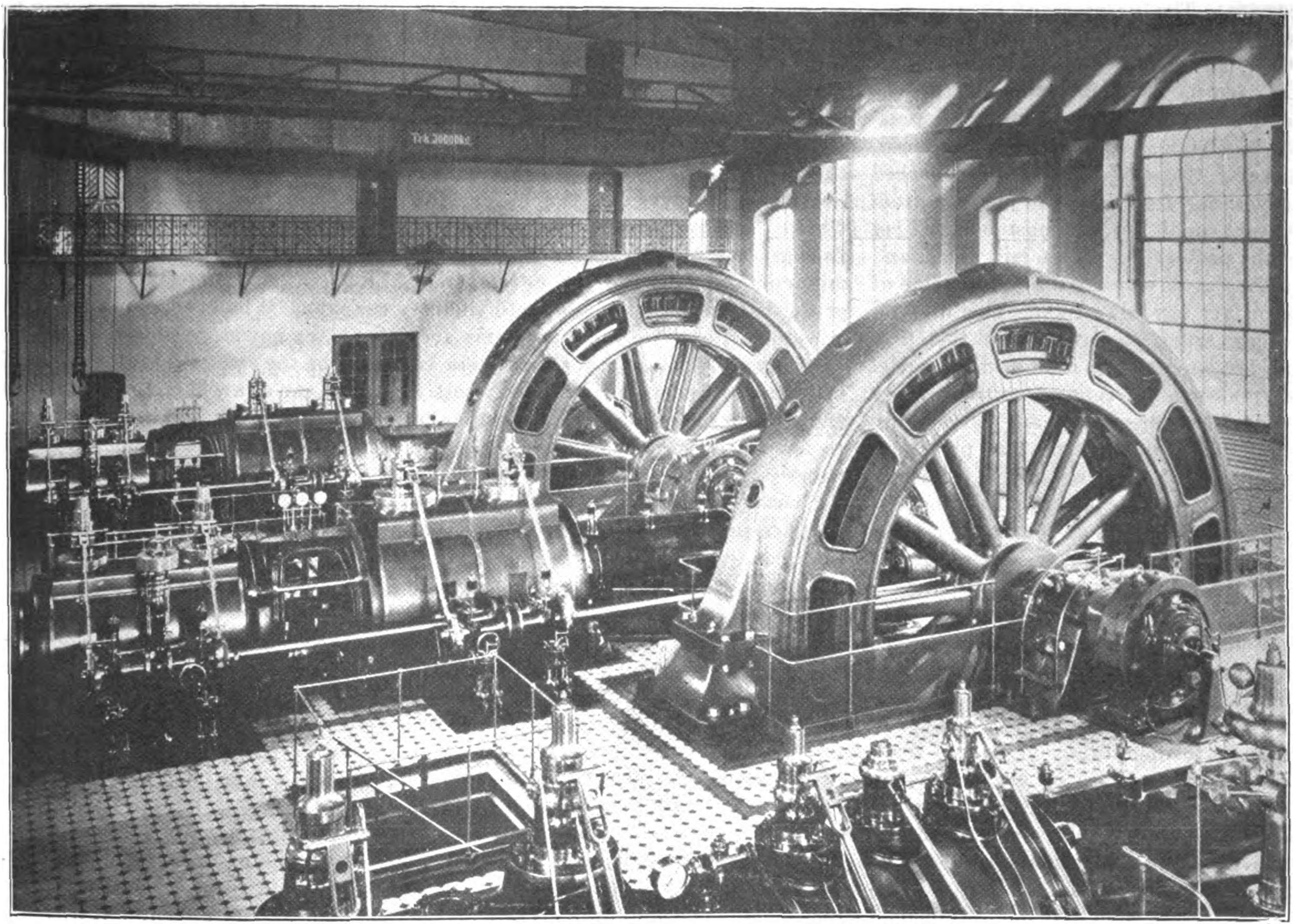
◆

The University of South Dakota, located at Vermilion, is anxious to secure the services of an assistant professor of engineering; salary $1,200 for the first year.

DRESDEN ELECTRIC LIGHT AND POWER PLANTS.

BY FRANK C. PERKINS.

The city of Dresden, Germany, has a population of nearly half a million, and is well provided with electric stations supplying current for railway, lighting and general power purposes. The Dresden Electricity Works, shown in the illustration, contains two alternators of 1,000 kilowatts, each direct connected to horizontal tandem compound engines, operating at 85 revolutions per minute, and two revolving field alternating current generators, each having a capacity of 850 kilowatts, and directly coupled in the same manner to the same type of engines at the same speed. These alternators are of the Lahmeyer type constructed at Frankfort-on-the-Main, Germany, by the Elektricitats-Actien-Gesellschaft, W. Lahmeyer & Co. The station is served by an electrically-operated crane of 30,000 kg. capacity, as noted in the background of the illustration. The normal capacity of this station at the present time is 5,080 kilowatts, and it supplies current for 92,952 incandescent lamps of 50 watts and 1,572 ten ampere arc lamps. The primary current is 2,000 volts, the secondary distribution being made at 72 and 110 volts. The motor service includes a large number of small motors having a total capacity of 1,169 hp. The station is connected with 2,390 meters, this being the usual method of charging for the electric service.



Dresden Central Station.

A combined lighting and heating plant was installed at Dresden, supplying heat and light to the King's palace and various public buildings in the vicinity. This power house was electrically equipped by the Allgemeine Elektricitats Gesellschaft of Berlin, with the exception of two steam engines and generators, the storage battery installation and the main switchboard in the power house, which was supplied by the Elektricitats Werken, formerly O. L. Kummer & Co., of Dresden. The boilers and steam piping of the combined lighting and heating power house were installed by Messrs. Rietschal and Henneberg of Dresden. There are ten boilers, including the reserve, each having a heating capacity of 2,151 square feet. These boilers also supply steam to the three direct current steam dynamos. The electrical generators each have a maximum capacity of 360 kw., the pressure being 220 volts at the terminals, and a balancer has been provided, as the three-wire system of distribution was adopted. The storage battery consists of two sets, each having two groups of 132 cells, coupled in parallel, the capacity of each part being 1,080 ampere hours. The battery has a normal charging and discharging rate of 360 amperes with the above capacity.

There are four electric railways in Dresden, including the Kgl. Sachs. Statsbahn, having a total length of track of 14.25 kilometers; the Dresdner Vorotsbahn, with a total length of track of 3.6 kilometers; the Dresdener Strassenbahn, with 61.96 kilometers of track, and the Deutsche Strassebahn Gesellschaft, with 58.85 kilometers of track. These electric railways are supplied with current from the city electric power plant, also from the Elektricitats Werk Deuben, and from a power house at the Bahncentrale Tolkewitz, the total current utilized from these various plants being from 1,500 to 2,000 kw. The cars are equipped with motors of from 16 to 25 hp. each; several hundred cars are used, about half of which are trailers, together with about 40 storage battery cars.

For a city of its size Dresden is as well provided with electric railway, light and power service as any of the larger cities in Germany.

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ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

Electric Railways.

Application of the Motor to Railway Service.—The inventors of electric railway appliances may be counted in multitudes, and their work in the aggregate has been the means of developing the possibilities of electric roads to their present high state. It must not be believed, however, that perfection has been reached as yet; far from it. Yet judging from present conditions, the most definite lines of the problem have been laid down, and further work will be mainly in the line of secondary improvements. The first recorded American inventor in this field was Davenport, who built a small model of an electric car running on tracks, very crude, yet operative, and thoroughly crystallizing the fundamental principles of electric railroading. It is perfectly reasonable to believe that among the first natural applications of the electric motor that would be made by experimenters would be that of applying it to some purposes of traction. As Jacobi applied an electric motor run by batteries to the running of a small boat on the river Neva and the same idea was followed by Trouve in France on the Seine, so it was found possible to operate tricycles and small four-wheeled vehicles by electricity, and naturally a small electric car. The effort has always been made to apply sources of motive power, particularly when they are new, to all known forms of propulsion. The step is an easy one—to include an embryonic vehicle to run on tracks or off—and thus to show the point of divergence of the two great inventions of this era: the automobile and the electric car. It is easy to realize that any experiments carried on in the initial stages of electric traction were destined to expand because of the new social conditions through which the density of population, by its rapid increase in large cities, called for some efficient and safe as well as rapid means of locomotion. The laboratory experiments and scientific tests soon became matters of public interest, and the question of whether the application of an electric motor to a railway truck would prove a success was soon answered in the affirmative. Such efforts as these, in this field of original work, beginning with the toy model of Davenport, have reached a point to-day represented by giant electric locomotives developing twice the power and pull of those employed on the heaviest grades of any steam road in the United States. Attention must now be turned to some of the important principles involved in a study of railroad work.

Some Mechanical and Electrical Principles Involved.—It is, of course, well known that a certain heavy mass mounted on wheels must be drawn along a pair of rails, the mass being a car, and the rails the tracks which act as guides for the car. Simple as the proposition seems at first glance, an immense amount of labor was involved in the original development of this idea.

The manufacture of the rails, the wheels, the car trucks, the system of springs, the air brakes and a host of minor details called for the development of special and ultimately gigantic industries to grapple with these problems successfully. Certain proportions were to be learned only by experiences of a costly and arduous nature and it is in a sense the review of these relationships and their underlying principles which constitute the basis of electric railroading. The simple mechanical problem of estimating the amount of power required to move a given mass a given number of feet in a given time is fundamentally the beginning of this study. Take a car weighing one ton and move it at the rate of 10 miles an hour. The question to be asked is this "What power is required to produce this velocity under ideal conditions?" A weight of one ton or 2,000 pounds moving at the rate of 10 miles an hour, or 52,800 feet, would be equal to a weight of 2,000 pounds moving at a speed of 880 feet a minute. One horse-power = 33,000 foot pounds per minute; therefore 880 × 2,000 = 1,760,000 foot pounds per minute or in horse power 1,760,000 ÷ 33,000 = 53⅓. The horse power obtained in this manner by calculation does not take into consideration the losses through friction, air resistance, slippage, etc., which must be added. In starting a car, the effort of overcoming its inertia is greater to instantly attain full speed than that developed at any other point in the process. It is of necessity a comparatively slow one in practice because of the inability of the driving wheels to grip the track firmly enough to move the suspended weight as rapidly as they rotate. Thus another principle is involved in connection with the amount of power required and this is the amount of friction between the wheels and the track. The greater this adhesion or friction, as far as the initial effort is concerned, the more rapidly acceleration will develop. The weight of the car will increase this, in conjunction with the width of the wheels and rails. The greater the number of points of contact between the car truck and the tracks the greater the effect in starting of the tractive effort. The relationship of these items is an interesting phase of general railroading and is therefore of the utmost importance in electric roads where the motive power is found under each car, practically directly over these very points of contact with the rails.

The motor employed to produce the driving force must develop sufficient pull to give the speed required. The motor may be high speed and geared by means of a pinion to the car wheels through the medium of the axle; or it may be slower in speed and directly connected to the car axle. Whatever course may be pursued, the power developed by the motor must be the equivalent of that required by the car as a whole, to reach its anticipated speed. In the last case cited the car weighed but 2,000 pounds; if its weight is greater, 5 tons for instance, the power required would be over 260 hp.

On the other hand, if the speed is increased to double, or 20 miles an hour, more than 520 hp. is necessary because of the increase in air resistance. It is evident, however, that if the air resistance is neglected, and the power required to reach a speed of 60 miles an hour is to be estimated, calculations of this character would show the necessity for developing 6 × 53⅓ × 5 = 1,600 hp. for a 5 ton car. The mechanical power, resulting from the transformation of the electrical energy in the case of an electric car, is transformed into an effort along a horizontal plane. The electrical energy sent in to produce this effect, measured in volts and amperes or watts, is transformed within the motor into a rapidly recurring series of magnetic pushes and pulls between the armature and field. The proportioning of this effort to that demanded by the weight and speed of the car is self-evident.

If a motor of 250 hp. is employed for traction purposes and it is desirable to know its carrying power at a certain speed, the following process is necessary: Reduce the electrical horse power to foot pounds per minute, divide the speed of the car in feet per minute into the foot pounds, and the value of the weight that is obtained is equal to that of *the car and the motor*. For instance, if the speed is to be 10 miles an hour with a motor weighing one ton, and the weight of the car and its appurtenances is to be known, reducing 250 hp. to foot pounds gives 250 × 33,000 = 8,250,000 foot pounds; 10 miles an hour = 880 feet a minute as the rate of speed at which entire weight can be moved. Dividing 8,250,000 by 880 gives 8,250,000 ÷ 880 = 9,375 pounds, or nearly 5 tons. If the motor weighs one ton, as stated, then the car and its appliances or load is limited on this theoretical basis to the difference between 9,375 and 2,000 pounds or 7,375 pounds. If the car carries 20 passengers of an average weight of 150 pounds apiece, included in this total of 9,375 pounds, then the subtraction made of 3,000 pounds for passengers and 2,000 pounds for the motor leaves a balance of only 4,375 pounds for the car body and trucks. The same general reasoning would apply to vehicles that do not run on trucks, such as automobiles, and in such cases a better response is obtained between the wheels and the ground than between the wheels of a car and the rails. The necessity for using heavy broad rails with corresponding wheel rims is obvious. To utilize the power of a motor economically, the wheels must not slip on the rails, particularly when starting. In street railway service these conditions are unusually severe because of the frequency of the stops and starts involved in the nature of such local service. The wear on the rails and wheels is relatively enormous, and the only means of satisfactorily withstanding the strain is to install an exceedingly solid roadbed, good steel rails and car wheels of the finest quality.

Watts and Foot Pounds.—The watts to be consumed by the motor are either estimated from the value of the load to be pulled and its rate of movement per minute, or from the motor direct, the weight and speed to be estimated from it. A 250 hp. motor equipment is not necessarily one motor; it is generally two and may be more, depending upon the length of the car body and the nature of the service. The pressure of a railway system is about 500 volts, thus reducing the current to a comparatively low value. The watts of a 250 hp. motor = 250 × 746 = 186,500, which at a pressure of 500 volts = 186,500 ÷ 500 = 373 amperes at full load. Although foot pounds are calculated in connection with horse power by the minute interval, and watts in a similar manner by the second interval, still the general rating of speed in miles per hour or feet per minute and of weight in pounds per car adjusts these differences. A 250 horse motor is producing power per second which entitles it to the rating it possesses. The power it produces per minute is only 250 hp.; the watts consumed are based upon the consumption per second, but the foot pounds ultimately given out per minute are no different from those given out by a steam or gas engine of the same rated horse power. Therefore foot pounds and watts can be transposed into each other by remembering that 33,000 foot pounds per minute is a rate of power measurement exactly equal to that of 746 watts per second.

Systems of Electric Roads.—A number of systems of electric cars have been designed whose ultimate object was the solution of the street car problem. Some of them have been tried with every sign of success at the start and have failed, others have been failures in the beginning, but are now established successes. The systems to which general reference is made are:

First—The well known overhead trolley system.

Second—The so-called third-rail system.

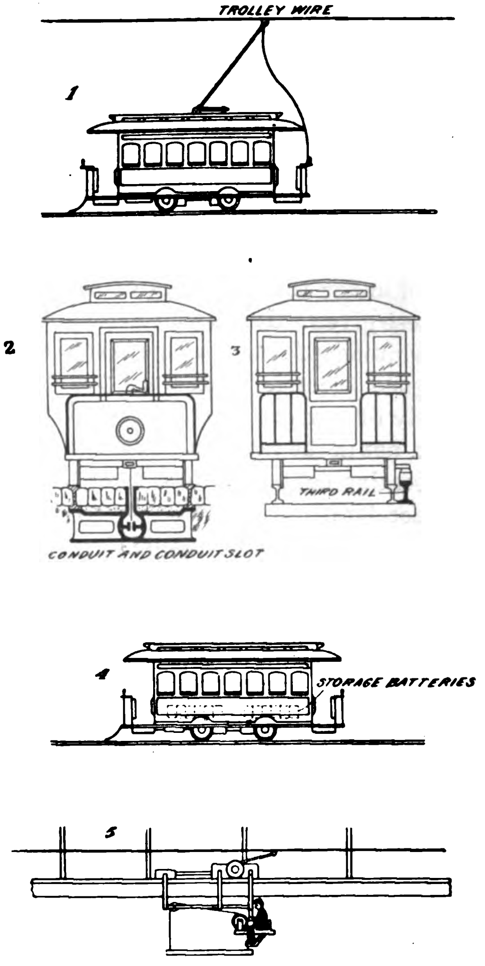
Third—The open conduit or slot system.

Fourth—The storage battery car system.

Fifth.—The automatic or electric block system.

Sixth—Telpherage and miscellaneous systems.

It is not difficult for the reader to realize that a selection of the correct system, from among this collection, suited to the special needs of cities and to suburban use, was a matter calling for the greatest sense of discrimination. It has been pretty well settled in New York that the open conduit is best suited to the peculiar requirements of the people. These requirements have been in part the result of special legislation, through which it became imperative to place all wire underground, thus excluding the overhead trolley entirely. The storage battery system was in operation for a few years under the title of the Julian system, but it did not succeed on account of the wear and tear of batteries, the difficulty of handling the same, and the possibility of breakdowns in the midst of busy thoroughfares. Other evils added their weight to the problem, with the result that a continuation of the experiment would have led to great financial sacrifices. The storage battery belongs to other fields, and experience has shown that its utility can only be profitably exhibited in them. The open conduit system was a failure for many years because of the imagined difficulty of keeping the conduit clean, and in other respects because of the inefficacy of such new improvements as were introduced to make it a success. Insulation, drainage and a system of manholes for inspection were the elementary considerations. Along with them came the correct development of a solid and effective method of construction, with the result that the system now in operation in New York City is the greatest in the world. One of the influences which led to its general adoption, was the fact that the cable system employed practically the same conduit, which with a series of secondary changes was able to perform its functions in a purely electrical sense. Thus the system of wire rope transmission for street railway service paved the way for the introduction of the electric conduit in electric car service. Sewage connections were made adequate to drain the conduit, and a substantial form of insulator was introduced to support the two rails within the conduit acting as conductors. Ducts were laid along the tracks with feeders installed, and thus the various and at one time insurmountable obstacles were overcome. The peculiarities of street car service are such that a car must start rapidly, yet without too sudden an access of speed. In fact the very expression



1—The overhead trolley system. 2—The slotted open conduit system. 3—The third rail system. 4—The storage battery car system. 5—The telpherage or monorail system.

acceleration is employed to denote this idea in actual practice. To accelerate rapidly means a great gain of time in making trips of a given length, the net result of which is the use of more cars on the track going each way. To accomplish this successfully, powerful motors are installed in the cars, and it is this possibility more than anything else that has given to electric street railways their proven superiority over other systems.

Facts to be Considered.—Street railway service, from an electrical standpoint, which might now be considered as the only one of importance, calls for a consideration of the following items:

First—Acceleration of the car.
Second—Draw-bar pull of the car.
Third—Efficiency of the car.
Fourth—Station equipment.
Fifth—Rails.
Sixth—Cost per car mile for service and power.

There are more elements than these in connection with each part of the car and station, but the greater problems are included under the headings of such titles as these given. It is a well-known fact to superintendent and managers that a well designed electric road does not consist merely of perfect machinery and equipment, but in the rating and design of cars of a seating capacity, horse power, weight and acceleration suited to the conditions of service in a given locality,

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PROVIDING FOR INCREASE OF POWER IN ISOLATED STATIONS.

ARTICLE I.

BY W. H. WAKEMAN.

As there are many towns and villages where a limited number of electric lights and a few small motors would be used, provided they were available at reasonable cost, and as there are many capitalists who are willing to invest their money in such enterprises, if they are sure of receiving a fair rate of interest on their investment, suggestions concerning the best power plant equipment for present use, also plans for increase of power when wanted, are of interest to all concerned.

In every place of this kind the men who are interested in conducting the business on a profitable basis look forward with pleasure to the time when more machinery will be necessary to supply the requirements due to increase of population, and the popular demand for better lighting and power service.

An important point, which is not always given the attention it deserves, is that when a plant is designed and installed provision should then be made for the enlargement which in the natural course of events is to follow.

In these articles the power plant only is to be considered, and to those who are not familiar with problems presented in connection with economical steam engineering it may seem to be a simple proposition. So far as providing enough power is concerned it is simple, but when we remember that in order to secure best results the boilers and engines composing a plant must be proportioned to the load they are to carry, and as this load is not to remain constant it makes the problem more complicated and adds interest to its study.

Due consideration of these facts show that it is not the best practice to install one or more large boilers and give them a very light load at first, because the rate of combustion will be too low. I am not in favor of a very high rate of combustion, because it rapidly destroys brick furnaces and wears out boilers. It is not economical so far as the evaporation of water is concerned. Slow rate of combustion results in small repair bills, but is not economical, therefore a medium rate is recommended if the load is not to be changed very much.

If there is load enough to work one or more boilers nearly to their rated capacity it is well to install them, taking care to provide room for more in the same battery. It is always a good idea to have at least one more boiler than is required to carry the load, so that the engineer can take all the time he deems proper to clean or repair one of them whenever necessary, rather than to cool it off quickly, do the job in a hurry under unfavorable conditions, resulting in unsatisfactory work, then fill it with cold water while it is still hot and fire it up as rapidly as possible.

The rate of combustion mentioned refers to the number of pounds of coal burned per hour on each square foot of grate surface, therefore if there is one large boiler with a grate that is large accordingly the rate may be too low. In such a case it may be raised, without burning any more coal, by covering a part of this grate with fire-brick. When the load is increased these brick can be removed, thus making it possible to run the boiler to its full capacity.

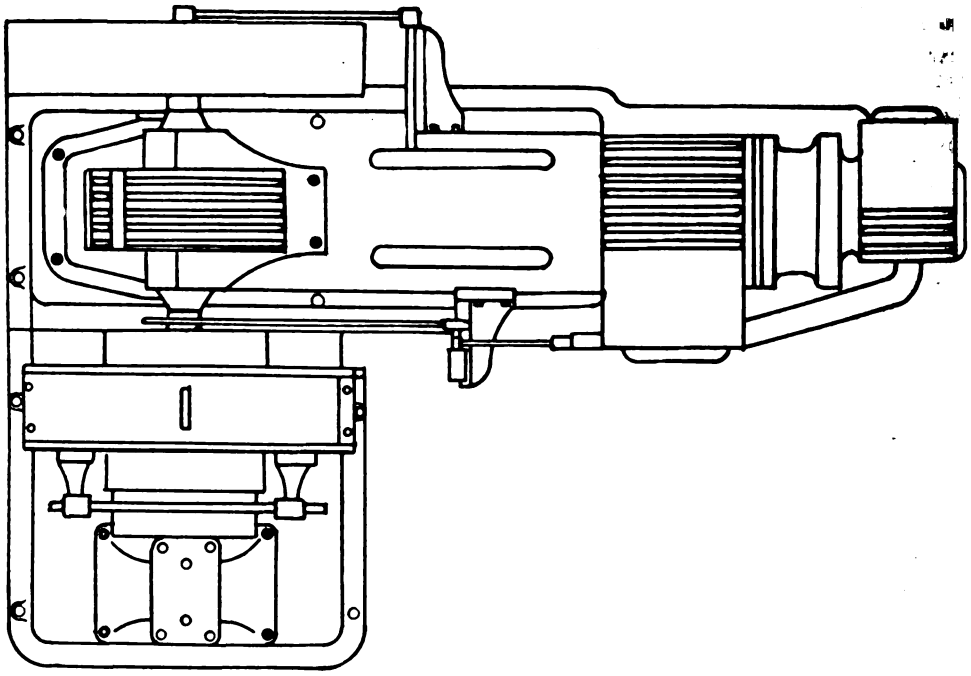

Fig. 1.

Boilers for this service should be designed and built so as to be safe when carrying at least 125 pounds pressure. While the load is light it may be a good idea to carry about 75 pounds, then when it is increased the working pressure may be raised accordingly. As boilers grow old it is necessary to reduce the limit of pressure allowed, according to the condition of plates and tubes, therefore they should be strong enough for a high pressure when new.

Coming now to the engine required, we find that there are several ways of providing for more load in the future. Fig. 1 is the plan of a short direct connected high speed engine of the tandem compound type. These engines are usually calculated for high boiler pressure in order to secure the best economy, which means that the steam cylinders are small for the required service. If a comparatively low boiler pressure (say 75 pounds) is to be used during the first year, and the first machine is to be worked to the full capacity of the generator on the crank shaft, it becomes necessary to secure a larger steam cylinder.

There is a high speed direct connected engine near my desk which is singing softly as I write. On this size the makers usually put a 10-inch steam cylinder for 120 pounds boiler pressure, but as I carry only 70 a 12-inch steam cylinder was used and it gives satisfaction.

Perhaps one of these units will be enough for the first year, and when more power is wanted another can be installed, followed by others of the same kind when wanted. The objections to this plan are that a station filled with small, high speed units requires more care and attention than where a less number of larger units are used. Furthermore these engines are not as economical in the use of steam as some other kinds.

Fig. 1 illustrates a tandem, as before mentioned, which is more economical than a simple engine when the load is just right, but otherwise it may give no better results than the less expensive simple engine. This refers more especially to non-condensing engines.

THE OSMIUM LAMP.*

The total energy radiated by a heated body is proportional to the fourth power of the absolute temperature of the body. As the temperature increases, the percentage of the short waves emitted, as compared with those of long length radiated, increases also very rapidly; but the absolute value of this percentage varies for different bodies, being smallest in so-called "black" bodies, but comparatively high in bodies with a metallic luster and smooth surface. Only these short waves, it need hardly be said, are observed as light. An efficient light-giving body must, therefore, withstand very high temperatures; its radiating surface, at a given efficiency, should be as large as possible; the substance of the filament should be transparent or white to minimize the effects of blackening; the surface of the filament should not become blacker or rough with use, and its resistance should increase with increasing temperature.

Osmium, generally in the form of osmium-iridium, is found in platinum ores and also in gold sand with gold and silver. It is at present usually obtained by alloying the residue which remains when platinum is dissolved in aqua regia, with metals, such as zinc, lead or tin. The osmium-iridium passes thereby into a finely-divided state and if it is now heated in a current of oxygen it will split up into osmium tetroxide and iridium. Osmium may then be obtained by treating the osmium tetroxide with any reducing agent.

When Herr Auer von Welsbach invented the osmium lamp some six years ago, he found it impossible to draw osmium in form of wire, and he first tried the expedient of coating platinum wire with osmium and evaporating subsequently the greater part of the platinum. It was observed, however, that a platinum-osmium alloy was formed which—when containing more than 4 per cent. of platinum—began to melt when the platinum was being evaporated. In order to keep the percentage of platinum below this figure, the finished filament had to be made about five times thicker than its platinum core. As uniform platinum wire was not obtainable in thicknesses less than 0.02 mm., it will readily be seen that the osmium filaments could not advantageously be made in diameters below 0.1 mm. Such filaments, however, are not suitable for lamps consuming less than 1 ampere.

The next and final step was to mix most finely divided osmium with certain organic binding substances to a thick tenacious paste. This paste is forced under high pressure through a diamond or sapphire die on to a card which is moved about in such a manner that the filament is deposited in loops. After drying, the organic binding substance is carbonized by heating the filament in vacuo. This porous filament, rich in carbon, is then gradually heated to an intense incandescence by an electric current in an atmosphere containing much steam and a certain quantity of reducing gases. The carbon of the raw filament changes into carbon oxide and carbon dioxide, and after a relatively short time the filament consists of pure, or very nearly pure, osmium only, the percentage of carbon being insignificant. Although the density of the filament has greatly increased during this process, the filament is still porous and its surface is far from smooth. After trying unsuccessfully several means of connecting the filament to the platinum leads, it was found that a very satisfactory method was to fuse them together by the electric arc. Osmium is brittle when cold, but soft when heated, and for this reason the lamps as made at present are required to burn in a definite position.

When the manufacture of this lamp was taken up by the Deutsche Gasgluhlicht Actiengesellschaft, the highest voltage that the lamp could stand was 27 volts. After the lamps had been perfected to burn at 37 volts, they were put on the open market. The lamp voltage was soon after brought up to 44 volts, and during the last few months a considerable number of 55 and 73-volt lamps have been sold. Quite recently 110-volt lamps have appeared.

The filament of an osmium lamp for 37 volts, 25 cp. (Hefner units), consuming 1½ watts per candle power, has a diameter of 0.087 mm. and a length of 280 mm. The radiating surface is from 3 sq. mm. to 3.2 sq. mm. per candle power. If an ordinary glow lamp be run at 1½ watts per candle power, its radiating surface per candle power is only 1.6 sq. mm. The carbon filament, therefore, must be both hotter and "blacker" than the osmium filament. With an increase of voltage of 10 per cent. the current increases 6.5 per cent. in the case of the osmium lamp, and 12 per cent. in the case of the carbon filament lamp. The corresponding increase in illuminating power is 40 per cent. and 80 per cent. respectively.

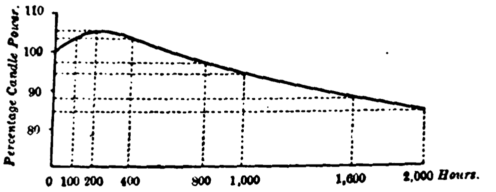

FIG. 1.
Percentage and variation in candle-power of 37-44 volt and 25-32 (Hefner) cp. Osmium Lamp.

It is not possible to state definitely the life of an osmium lamp, but 5,000 hours have been repeatedly exceeded. Figs. 1 and 2 represent the relationship of illuminating power to time—for a 37-volt lamp and 110-volt lamp, respectively. Blackening of the bulb is very rare (observed in 10 per cent. only of the lamps investigated so far).

The surface of the lamp filament is at first somewhat rough, but it gradually becomes smoother and this is the reason why the candle power increases during the first 250 hours or so. Before the lamp is ready for sale, it is burned in the factory for several hours in order to bring the lamp up to an approximately steady state.

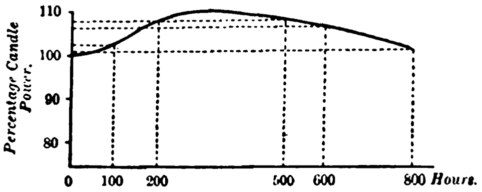

FIG. 2.
Percentage of variation in candle-power of 110 volt 32 (Hefner) cp. Osmium Lamp.

If the lamp is run at less than 1½ watts per candle power, the structural changes in the filament occur too rapidly for practical purposes. Nevertheless, lamps consuming 1 watt per candle power only, have been observed to burn for several hundreds of hours without decrease in light. When exposed to hard shocks, the osmium lamp filament is more liable to break than the carbon filament, but if properly packed the loss through breakages in transit is small, being only about 1½ per cent. These lamps stand the shocks of railway carriages and omnibuses very well. The osmium lamp is efficient also for very low voltages and a large number of 2-volt lamps for mines are in use in connection with portable accumulators. For a long time it was not possible to make thin filaments, but recently it has become feasible to reduce the diameter down to 0.03 mm.

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*Abridged translation of a paper read by Herr Fritz Blau before the Elektrotechnischer Verein of Berlin, Jan. 24, 1905. From the "Electrician," London.

After the paper had been read, Prof. Wedding mentioned some tests which pointed to the fact that the blackening of the bulb in ordinary carbon filament lamps had no marked effect in diminishing their candle power. Amongst a large batch of ordinary 16 cp. incandescent lamps he was testing there were four which burned 14,000 hours. During this time the illuminating power fell to 5 cp. and 6 cp. The original glass bulbs, which, of course, were much blackened, were then replaced by fresh ones without damaging the filament. The illuminating power, however, had not benefited to any extent by the substitution, and Prof. Wedding concludes from this that the black deposit inside an incandescent lamp of the carbon type screens very little light.

SERIES ALTERNATING ARC LIGHTING.*

BY E. P. WARNER.

(*Concluded from page 154.*)

The durability of a lamp and the adaptability for long continuous service depend to some extent on the parts of the regulating mechanism remaining at a reasonably low temperature. In order to obtain such low temperature parts must be made of sufficient size and superficial area to readily dissipate the heat generated by losses in the mechanism and heat which may be conducted from the arc. The rise in temperature by such mechanism after a run of 12 hours should not exceed 50 degs. C. above the temperature of the surrounding air.

In the choice of inclosing globes it has been found that ordinary clear glass gives the greater general satisfaction, the distribution or diffusion of the light from the arc effected by the globe being practically as good as from any form of tinted or opalescent globe after one or two hours' operation. Practically the only reflector which can be used in combination with the alternating arc lamp is one placed above the arc and outside of the outer globe. I would say in this connection that certain users are making use of the reflector without employing an outer globe, making use of special tempered glass inner globes, which will stand the action of the elements very well. This is even accomplished in tower lighting, where the force of the wind is very great and rain and snow have full sweep. Reflectors which are very small cannot be applied practically to the alternating arc, for the reason that the upper lobe of light is so disposed that it cannot reach a reflecting surface which is very close to the central line of the lamp. This is true of the conditions in all positions of the arc in the inclosing globe. Effective reflectors can be and are applied which are so nearly flat disks that they do not offer much surface to the wind and hence do not cause the lamps to swing badly. The point has been raised that owing to the deposit of semi-opaque material up on the inner surface of the globe, the lighting efficiency is very materially reduced after a run of 40 or 50 hours and that the deposit of this material is determined to some extent by the character of the gas cap or plate which closes the upper end of the globe. We have found this to be true to a very limited extent and that the lamp which had the metal gas cap conducted away the heat from the inner globe more readily and caused the lamp to run with a lower temperature in the inner globe, and thus to deposit less of the objectionable material upon the surface of the globe.

Another result of this lower temperature was the fact that some of the material so deposited was burned into the surface of the glass, as is often the case in lamps where a high temperature is maintained. It follows, therefore, that the general lighting efficiency of a lamp with a metal gas cap is considerably higher than without.

It has come to my attention in a number of cases that the central station men engaged in making preliminary tests of arc lamps, have endeavored to compare the different lamps offered on the basis of number of hours' service with one trimming. In this they have apparently lost sight of the fact that the number of hours' service with a trimming is controlled solely by the carbons, and the amount of light given, the lamps having in fact nothing whatever to do with the result. In order to give a good steady light of sufficient power, it is necesssary to admit a certain amount of air to the inclosure, restricting this amount only to the point where high lighting efficiency and reasonable length of life are obtained. We reach a point in this line of research where one line crosses the other; there we must stop, knowing that a displacement in either direction will give unsatisfactory results.

In this connection I would say that nearly all the reputable manufacturers of arc lamps of the present day are practically unanimous as to the most desirable conditions in respect to the above features, and it is only the unprincipled dealer who tries to influence the customers by claims for greater life that can be given with satisfactory lighting power.

In conclusion I would say the results which have been achieved in series alternating arc lighting, during the past three years, are of a character to give confidence to the central station engineer, that the system has come to stay, and is one which may be safely adopted with all the probable contingencies which may arise in the near future well in view.

THE ELECTRIFICATION OF ENGLISH CANALS.

(From our London Correspondent.)

The canal system, which before the railway period served English manufacturing industries so well, is to-day to a very large extent under the thumb of the great railway companies. The canals were absorbed from 1821 onwards by their rival, the railway, for the purpose of stifling competition. During the last few years there has been a great outcry against this stifling process and the high railway rates which it has encouraged, and this outcry is becoming louder every year. The matter is very much to the fore at this moment, both as the result of attention which has been given to it by the great Chambers of Commerce, and as the result of proposals for Government confiscation of neglected or inefficient canals. The question of electrification quite naturally fits in with the proposals to revivify them. In the course of a valuable contribution read by Mr. B. H. Thwaite, before the London Society of Engineers on March 6, the author gave some interesting facts relating to recent work, and an estimate of the cost of nationalizing and electrifying the entire

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* Paper read at the 13th annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., Jan. 18-20, 1905.

English system. He said that the narrow width of the average towpaths and their constructional character, makes any system that relies on the tractive effect of a locomotive running on the towpaths more or less impracticable; and it is obviously irrational to suggest a method of haulage that requires considerable energy on overcoming the haulage instrument *per se*. These two difficulties were considered to put out of court all systems of electrification that involve the employment of screw propellers with aerial methods of electrification or otherwise, and electrically-propelled locomotives traveling on the towpath, that rely on their own weight for the necessary adhesion qualifications. The Thwaite-Cawley electric horse system, the motor of which travels on light superposed steel rails carried by vertical standards erected at intervals along the extreme boundary of the canal towpath, is considered by English experts to be a solution to the peculiar conditions of English canals, and to permit of high practical efficiency being obtained. Some elaborate tests have been made in a German canal with an electric system, which is apparently a modification by Ganz of the Thwaite-Cawley system, and this gave a 68 per cent. efficiency of haulage effort. The locomotive has a hauling capacity of 37.5 hp., and is capable of hauling barges of 600 tons burden. The average working cost per kilo mile is stated to be equal to 0.05 pence with current at 1.4 pence per kw. The cost of a kw. would in Fngland be less than this.

The electrical energy would, for trunk canals, be transmitted at high pressure and transformed to lower pressures for distribution. Gas power generating stations would be located every 20 miles in the length of the canal. The tow paths would provide the way leaves for laying the high pressure conductors which would serve for a general supply at cheap rates to all areas through which the canal traverses. The locks, gates and sluices could be electrically actuated and electric capstans would provide the necessary elasticity to the haulage system. Then, further, the warehousing, hoisting, and conveying machinery could also be electrically actuated.

In his estimate of the cost of nationalizing and electrifying the 3,500 miles of Great Britain, Mr. Thwaite assumed that they would be purchasable at two-thirds of their original cost of construction, say £2,850 per mile of length. Allowing £500 per mile for the cost of standardizing the locks, and £2,000 per mile for electrification, a total of £16,975,000 was arrived at. The round figure of 20 millions was mentioned as leaving something in hand for working capital. It was pointed out that the electrification would provide a cheap supply of electric power for export service, as well as for pumping, irrigation, plowing, churning, milling and vegetable and flower growth, and go far toward securing a revival of agricultural prosperity.

Many efforts are being made to induce the British Government to take the matter seriously in hand, but it is doubtful, with so many pressing calls, whether 20 millions can be spared under current conditions.

MARCONI ON WIRELESS TELEGRAPHY.

On Friday, March 3, at the Royal Institution, London, Mr. Marconi gave a lecture on "Recent Advances in Wireless Telegraphy." The audience included many men of distinction, among whom were Lord Kelvin, Lord Rayleigh, Sir James Dewar, Sir William Crookes and Prof. J. A. Fleming.

The recent improvements in wireless telegraphy, to which especial reference was made by Mr. Marconi, included the means to prevent interference and secure independence of communication; also the research and experiment which aimed at increasing the distance over which communication was possible, and the means of more accurate and efficient working. The "Times" (London) gives the following abstract of the lecture:

The difficulty that messages sent by wireless telegraphy were liable to interference appeared more serious to the public than to the expert telegraphist, who knew that the same thing was possible with ordinary telegraphy, but that it was prevented by rules and regulations devised to that end. In some cases—as of a shipwrecked vessel calling for assistance—it was a positive advantage that the messages should be received by a number of other ships or stations. But the liability to interference must in some cases be recognized as a drawback; and, accordingly, he had endeavored to discover means by which it could be prevented, the principle of which he briefly described. By having several stations tuned or syntonized to different periods it was now possible to send to each one of them without the others being affected, and even five years ago it was possible to send and receive several messages simultaneously without one interfering with another.

Passing to detectors, or receivers, Mr. Marconi referred to the older coherers and decoherers, and then to the magnetic detector, which he had devised more recently, and which, after two years' experience, he was convinced was a much superior appliance. It was now used in those ships of the British Navy which were fitted with Marconi long-distance apparatus. At first it had the disadvantage that it could not be made to actuate a recording or writing instrument, the current impulse with which it worked, though suitable for producing a click in a telephone, being too rapid and sharp to have any appreciable effect on the tongue of a relay. But now, by altering the circuits and the character of the iron employed in the magnets, the impulse had been slowed down, so that it was possible to work a relay, and, therefore, a recording instrument. With the new arrangement high speed was attainable, and also automatic sending, and it had been worked satisfactorily for a distance of 152 miles overland. As to the speed of his apparatus generally, Mr. Marconi claimed that in 1898 he was able to send an average of 12 words a minute, and between Amsterdam and Chelmsford he had more recently maintained an average of 24.

The lecturer next made reference to the progress which had been made in the direction of long distance working. After touching upon the big stations in Cornwall and America, he said that his preliminary experiments of 1901 convinced him of the possibility of trans-atlantic wireless telegraphy. In the spring of 1903 the transmission of American messages to the "Times" was attempted, but owing to breakdown of the apparatus it had to be discontinued, and it was decided not to attempt the transmission of public messages again until certainty was insured. New stations were now in course of erection and he had no doubt that in a short time it would be demonstrated that transmission across the Atlantic was practicable and trustworthy. Comparing wireless with cable telegraphy, he remarked that the cable companies had many cables, so that the public did not hear of the breakdowns that occurred, though they did in cases where there was only one cable, as to the Scilly Isles. Having referred to the long-distance news service maintained between the shore and several Cunard liners, Mr. Marconi said that the differences in transmission by day and by night were noticeable only when long distances were concerned, the range by day being much less than by night. Clear sunlight and blue skies, indeed, seemed to act as a fog to the Hertzian waves, but such things were not general in England, where, accordingly, the conditions were usually very favorable to wireless telegraphy.

He then spoke of some criticisms directed against his efforts at transatlantic telegraphy by critics who thought wireless telegraphy would find its proper sphere in providing communication between ship and ship and ship and shore, and went on to describe an apparatus invented by Prof. Fleming for measuring the length of electric waves. Finally, he gave some details showing the extent to which his system was used. He had, he said, every confidence that wireless telegraphy would be able to provide communication between England and her Colonies and England and America more economically than the submarine cable, and meantime it was gratifying that it had already done something towards increasing the comfort and decreasing the perils of those that went down to the sea in ships.

METAL ANALYSIS BY ELECTROLYSIS.

Before a recent meeting of the London Faraday Society, Mr. J. G. A. Rhodin read a paper on "Mass Analysis of Muntz's Metal by Electrolysis, and Some Notes on the Electrolytic Properties of this Alloy." He described—his paper being illustrated by experiments—an apparatus which was specially designed by him for the purpose of the accurate and rapid determination of the copper content (which should lie between 60.5 and 61.5 per cent.) of Muntz's metal.

As about 40 to 60 "heats" of metal are cast every day, and it being necessary to obtain the results within 12 hours of the time of casting, the apparatus had to be such as to enable 100 analyses to be made in 24 hours—with a mean probable error of not more than + or − 0.1 per cent. The author decided that an electrolytic method would best fit in with these stringent requirements.

The electrodes employed consist of concentric cylinders of very fine platinum gauze, supported by stout frameworks in order to insure even current distribution. The anode rests on a ring at the bottom of the containing vessel so that the cathode can easily be slipped away and removed, and both electrodes are held in modified Classen stands. The present installation consists of 30 such unit cells, and current is supplied to them from six pairs of accumulators, each of which supplies current to five pairs of electrodes through suitable nickeline resistances.

One gramme of the alloy, dissolved in nitric acid, is used for an analysis, and a current either of 0.5 ampere or else of 2.0 amperes is employed for the deposition. In the former case deposition is complete in 12 to 15 hours, in the latter in three hours. Electrolysis proceeds in three phases: (1) Copper deposition and ammoniacal reduction of nitric acid. (2) Ammoniacal reduction only. (3) Deposition of zinc. A perfect separation takes place if phase (2) occupies a long time and is unaccompanied by metal deposition. If certain impurities, such as arsenic or nickel, be present they must be removed chemically. The paper described in detail the actual procedure at the works laboratory, and also included a table showing the kind of accuracy obtained in cases where re-analyses have been made. Since these analyses in bulk have been made it has been found that they act as an infallible guide to the casters, so that remelting has now become very rarely necessary.

In conclusion, the author discussed the electrochemical properties of Muntz's metal. The metal is largely used as a sheathing to protect ships' bottoms from certain mollusca and algæ, and to be successful it should dissolve in sea-water just to a sufficient extent as to render the surface poisonous, the best conditions being the equal dissolution of the copper and zinc. The author shows how these may be calculated approximately by supposing that the electrolytic dissolution rate is proportional to the heat of formation of the ultimate compounds (zinc and cuprous chlorides) and to the conductivities of the metals which dissolve. Assuming that both the chlorides of copper are formed, and taking the mean of the results in the two cases, the best values are found to be 60.811 per cent. of copper, and 39.189 per cent. of zinc, numbers which agree very closely with the results of practical experience. The author is now engaged in exhaustively investigating the absolute dissolution-velocity of pure Muntz's metal at a definite temperature, and he adds here a preliminary description of these experiments, describing in an appendix his most recent experiments on the subject. He finds that a binary alloy like Muntz's metal dissolves slowly at first, the velocity then quickly arrives at a maximum, then it falls suddenly—remaining almost constant for some time—and finally a more or less rapid fall again occurs. During the period of constant velocity the surface must alter as the resistance capacity, if the action is galvanic. The seat of the EMF. must be in the electrolyte, as the constancy of action indicates a steady EMF. of considerable magnitude. It is probable that the result is influenced by the actual mass of metal present, relative to that of the solvent. The external pressure certainly exercises a very considerable effect on the reaction-velocity, by influencing the speed with which hydrogen can leave the surface of the metal. The author promises further communications on the subject.

ELECTRIC LIGHTING TROUBLES WHICH MIGHT BE AVOIDED.

BY ALFRED H. MAYES.

Those who have had considerable experience of electric lighting installations can scarcely fail to have observed that the causes of breakdown or other trouble are comparatively few in number, and, consequently, the same class of fault presents itself again and again. Short-circuiting in lamp-holders is a prolific source of destruction to lamps, and frequently of far more serious damage. The cause is generally a stray strand from the end of the duplex conductor, which finds itself free from the remaining strands and manages to make contact with the opposite pole. The remedy for this trouble is simply to exercise more care in fixing the bunches of fine strands in their respective terminals. By far the most satisfactory plan is to burn off the insulation, which can be done without injuring the wires in the slightest degree, and then to tightly twist the strands into the semblance of a solid conductor, using the finger and thumb only for the operation. Should the pliers be brought into requisition for this purpose, the fine wires will certainly be bruised or broken, and the difficulty we are seeking to guard against will result.

The difficulty of obtaining a sufficiently high insulation resistance between the poles of the whole installation is not an unusual trouble, and is sometimes due to a little-suspected cause—that is to say, the employment of a cheap class of poorly-insulated duplex cord in some of the fittings. When one realizes that the positive and negative poles of the system are closely twisted together, the necessity of high class flexible cord is at once apparent, especially so in damp or exposed positions.

Serious loss and annoyance to users of the electric light is frequently caused by the "blowing" of sub or main fuses. Whilst fully recognizing the importance of not providing too much carrying capacity in fuses, it must also be borne in mind that if the capacity is cut too fine, that the premises may be plunged into darkness owing to a momentary and trifling increase in the supply voltage, and this frequently happens, causing much difficulty to the unfortunate consumer, who frequently has trouble in obtaining the services of an electrician to put matters right, especially should it occur late at night.

As anything tending to bring electric lighting into disrepute is strongly to the disadvantage of wiring contractors, attention to the foregoing hints will be amply repaid by increased satisfaction to uses.—"Electrical Engineer," London.

Marconi Married.

Mr. William Marconi was married on Thursday last at the Catholic Church of St. George, in London, to Lady Beatrice O'Brien. Lady O'Brien brings to her husband a dowry of $30,000 a year.

American Institute of Electrical Engineers.

The 195th meeting of the American Institute of Electrical Engineers will be held at the chapter room, Carnegie Hall, 154 West 57th street, New York, on Friday, March 24, at 8:15 P. M. The following papers will be presented and discussed:

"Line Construction for High-Pressure Electric Railroads," by George A. Damon.

"High-Pressure Line Construction for Alternating Current Railways," by Theodore Varney.

"Application of High Pressure to Electric Railroads," by Ernest Gonzenbach.

March Reunion of Society of Mechanical Engineers.

The March reunion of the members of the Society of Mechanical Engineers in New York will take place on the evening of Tuesday, March 28, at 8:15 o'clock. The paper of the evening will be entitled "Formation of Anchor Ice and Precise Temperature Measurements," by Dr. Howard T. Barnes, assistant professor physics, McGill University, Montreal.

Pushing Business on the Coast.

The Standard Underground Cable Company announces that, on account of the general growth of its business on the Coast, it has decided to discontinue all agency arrangements for the sale of its products, and on April 1 will open its new offices in the Rialto Building, San Francisco, with Mr. A. B. Saurman as manager for the Pacific Coast territory, which includes Washington, Oregon, Idaho, California, Nevada, Arizona, British Columbia, Alaska and the Hawaiian Islands. Mr. Saurman has in turn been connected with the Standard Underground Cable Company in both construction and sales departments at Philadelphia and New York, and was later for several years manager of the Boston office, while for the past two years his position has been that of manager of the Pacific Coast sales department.

The Standard Underground Cable Company expects to make early announcements of location and personel of sub-sales offices at Los Angeles and Portland. It also reports that its factory at Oakland, Cal. (the only factory west of the Mississippi equipped with lead presses for cable work), has been unusually busy during the past six months, and that the future on the Coast points to its continued activity.

"Diamond H" Automatic Flush Receptacle and Plug.

Flush Recptacles and Plugs are a convenient means of obtaining current for various purposes, such as portable lights, fan-motors, etc., in different parts of the room.

At the time of building and wiring a house, the exact location of pieces of furniture requiring a good light, as tables, desks, pianos, etc., is uncertain. Therefore, the installation of several receptacles in the base board of a room will be very advantageous in that it permits the placing of a piece of furniture anywhere in a room—so far as obtaining light for same is concerned.

After the location of the receptacles is determined, there remains the selection of that receptacle which can be used with the least trouble to the operator; and which, when not in use, will be automatically closed, with no chance of accidental opening, and into which metal things of all sorts cannot be inserted by the inquisitive small boy—with unpleasant and oftentimes painful consequences.

Two features of almost equal importance with the automatic closing of the holes in the face-plate, are the automatic opening of same by the simple insertion of the plug in making the connection, and a construction which renders the accidental grounding of the circuit on the face-plate, when making the connection, impossible.

The use of one hand, only, in making the connection, is another desirable feature.

The "Diamond H" Flush Receptacle and Plug, manufactured by the Hart Mfg. Co., of Hartford, Conn., seems to embody all of the features necessary for a perfect device, and its specification by architects and engineers will result in the same eminent satisfaction to the user that "Diamond H" switches have always afforded.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MARCH 14, 1905.

Electric Railways and Appliances.

784,639. Electrical Trolley. Seneca R. Stoddard, Glens Falls, N. Y. Filed March 21, 1903. Renewed Aug. 12, 1904.

784,678. Trolley Catcher and Retriever. William W. Hoffman and Francis W. Powers, West Lafayette, Ind., assignors to the Electric & Steam Railway Supply Company, same place. Filed Sept. 23 1904.

784,681. Trolley-Guide. John F. Jameson, Plimpton, O, Filed Dec, 21, 1904.

784,741. Insulated Rail-Joint. George L. Hall, New York City. Filed Jan. 9, 1904.

784,814. Railway-Motor Control. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 20, 1904.

784,843. Trolley. Michael O. Day, Newcastle, Pa. Filed Dec. 20, 1904.

784,865. Electric Train Signaling Equipment. W. Britton Lane, Evanston, Ill. Filed Dec. 21, 1904.

Electrical Machinery and Apparatus.

784,547. Brush-Holder for Dynamo-Electric Machines or Motors. John F. Card, Three Rivers, Mich., assignor to the Sheffield Car Company, same place. Filed Oct. 1, 1903.

784,555. Junction-Box for Electrical Conductors. John Fountain, Jr., Elizabeth, N. J. Filed Nov. 13, 1902.

784,626. Electric Sparking Igniter for Explosive-Engines. George McCadden, St. Cloud, Minn., assignor to Frank Zins, same place. Filed June 22, 1903.

784,680. Sewing-Machine Motor Attachment. Francis P. Huyck, Swanton, O. Filed June 4, 1903.

784,712. Electric Central-Station Recording Mechanism for Meters. Chester H. Thordarson, Chicago, Ill. Filed Oct. 28, 1903.

784,718. Electric Solenoid. Ludwig S. Walle, Brooklyn, N. Y., assignor to Fridtjof Jebsen, Bergen, Norway. Filed Dec. 29, 1903.

784,807. Dynamo-Electric Machine. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 1, 1904.

784,869. Electric-Elevator Control. Niles O. Lindstrom, Jersey City, N. J., assignor to Alonzo B. See and Walter L. Tyler, New York City. Filed Nov. 17, 1904.

Telephones and Telephone Apparatus

784,546. Coin-Operated Telephone-Locking Device. William Calhoun, New York City, assignor, by mesne assignments, to the National Telephone Lock Company. Filed Sept. 18, 1903.

784,557. Telephone-Call. Peter T. Geyerman, Brewster, Minn. Filed April 29, 1904.

784,588. Party-Line Selective System. Frank P. O'Conor and Frederic McNeill, Lasalle, Ill. Filed Feb. 13, 1904.

784,605. Telephone-Operator's Key. Louis W. Wanemaker, Genoa, Ill. Filed May 11, 1904.

784,635. Relay. Micheal Setter, Chicago, Ill., assignor to the American Electric Telephone Company. Filed April 5, 1902.

784,720. Telephone Signaling Means. Klas Weman, New York City. Filed June 4, 1904.

Miscellaneous.

784,529. Telegraphic Transmitter. Martin Armstrong, St. Louis, Mo. Filed Dec. 29, 1902.

784,592. Apparatus for Effecting Electrolysis. Herbert Philipp, Wyandotte, Mich. Filed Aug. 10, 1903.

784,617. Electroplating Apparatus. Herman Fleischer and Charles H. Fleischer, New Britain, Conn., assignors to the Stanley Works, same place. Filed May 23, 1904.

784,732. System of Electrical Distribution. Rufus N. Chamberlain, Depew, N. Y., assignor to the Gould Storage Battery Company, New York City. Filed June 12, 1903.

784,766. Electric-Conductor Union. Frederick W. Sorg, Englewood, N. J. Filed Aug. 17, 1903.

784,790. Guide for Battery-Stems. Charles F. Hawley, Heppner, Ore. Filed April 23, 1904.

784,858. Combined Typewriter and Telegraph-Transmitter. Cyrus H. Hepinstall, St. Thomas, Canada. Filed Feb. 1, 1904.

784,860. Traingraph. William A. Inwood, Colorado Springs, Col. Filed Aug. 16, 1904.

784,885. Method of Extracting Metals from Ore by Electricity. Edward L. Priest, Oakland, Cal. Filed April 5, 1904.

Reissue.

12,324. Trolley-Wheel Guard for Electric Wires. John L. Sullivan, Warren, R. I., assignor of one-half to Joseph Harris, same place. Filed Jan. 26, 1905. Original No. 777,049, dated Dec. 6, 1904.

THE TELEPHONE WORLD.

Independent Men Meet in Binghamton.

A recent meeting of Independent telephone men of the Binghamton district of the New York State Independent Telephone Association was held in that city. George B. Wright, of Binghamton, was made temporary chairman, in pursuance to a call of the New York State Association, and for the purpose of organizing the Binghamton district association.

This district comprises the various Independent telephone companies operating and doing business in Cortland, Chenango, Broome and Delaware Counties.

The organization is made up of practical telephone men and flattering reports were received, covering the growth financially and physically of the various interests represented,

The following companies were represented: Nanticoke Valley Telephone Company, Gurney Smith; Killawog Telephone Company, C. K. Tarble; Lisle Rural Telephone Company, M. L. Sternberg; Marquis Telephone Company, J. B. Marquis; Whitney Point & Glen Aubrey Telephone Company, C. E. Slacker; Delaware Valley Telephone Company, C. B. Teed; Riverside Telephone Company, George Hyatt; Chenango Valley Telephone Company, Fred M. Harding; Lester Telephone Company, H. A. Williams; York State Telephone Company, George B. Wright.

It was reported that nearly 6,000 Independent telephones are in operation in the Binghamton district and that extensive building of new lines, in addition to those already under construction, is planned everywhere.

Officers were elected for the ensuing year consisting of J. B. Marquis, Jr., Norwich, chairman; F. M. Harding, Chenango Bridge, vice-chairman; M. L. Sternberg, Lisle, secretary and treasurer.

The next regular meeting of the Binghamton district will be held April 18.

The Grand Prairie Telephone Company was lately organized at Carlisle, Ark., the officers being as follows: E. C. Holt, of Lonoke, president; H. I. Buechley, of Carlisle, secretary and treasurer; J. E. Tunis, of Carlisle, general manager. The new company will incorporate at once, and build a line from Hazen to Carlisle, for both local and long-distance service, and will control a solid metallic circuit of two wires between Carlisle and Lonoke, for toll service only, which will connect at Carlisle with the Jacksonville Telephone Company, thus affording service with all the subscribers of the 'phones of this company, and giving a long distance line to Little Rock. The company expects to unite with another Independent company at Hazen, which will give connection with DeVall's Bluff and Stuttgart in the near future. All the poles are up between Lonoke and Hazen, and the wire will be in place shortly. Other wires will be strung on the poles for the use of Carlisle subscribers.

The Northwestern Telephone Company will spend some $25,000 in improvements in Owatonna, Minn., during the coming summer. A complete new battery system will be installed.

The Farmersville O., Telephone Company has amended its charter enlarging its purpose.

Nebraska Has Another Independent Company.

The organization of the Kearney Telephone Company has been completed and the officers of the company are: T. E. Parmelee, president; Warren Pratt, vice-president; W. S. Clapp, secretary and treasurer; W. J. Stadelman, general manager. These with F. H. Gilcrest constitute the board of directors. The new corporation has acquired the plant and business of the Home Telephone Company, the Kearney and Northwestern Telephone Company, and the Overton Telephone Company, all three of which systems will be operated in conjunction and under one management; the toll lines east and west are to be equipped with copper wire and other improvements are to be made, which will make the system one of the best and most profitable in the State.

It has been announced that after April 1 the telephone rate to all boroughs in New York City on calls from public telephone, will be 10 cents. There will also be a reduction in charges to subscribers. The Merchants' Association is informed that there will be no legislative investigation of telephone charges in the city.

The telephone monopoly in Connecticut, represented by the Southern New England Telephone Company, was drawn and quartered by the Glastonbury Business Men's Association at a recent meeting. In addition to speaking freely about that concern, steps were taken to assist the rival company, which has been trying to get into that State to accomplish its purpose. The Glastonbury representatives will go before the Legislature with their grievances.

At an adjourned special meeting of the stockholders of the Mexican Telephone Company, it was voted to sell the company's plant to the Mexican Telephone & Telegraph Company. The latter concern was recently organized under the laws of the State of Maine.

It is said that the Markles, of Hazleton, Pa., will have a large interest in the reorganization of the Keystone Telephone Company. It is proposed to put out a new bond issue that will take up all floating debt.

A dispatch from Toronto, Ont., says that 35 telegraph operators of the Middle and Eastern Divisions of the Grand Trunk Railway have received notice of dismissal. The company, it is said, will adopt the composite telephony system.

At a meeting of the citizens of Trimble County, in Milton, Ky., it was decided to form an Independent telephone company to connect Bedford and Milton and other points in the State. The capital of the concern will be $15,000.

The New England Telephone & Telegraph Company will ask the Lowell, Mass., city government for permission to place the remainder of its wires in that city underground.

The Farr Telephone & Construction Supply Company, of Chicago, Ill., has increased its capital from $10,000 to $25,000.

United States Telephone Company.

The directors of the United States Telephone Company, of Cleveland, O., have declared the regular annual dividend of 6 per cent. on the preferred stock, payable quarterly. The following officers were chosen: F. S. Dickson, president; H. A. Everett, vice-president; James B. Hoge secretary, and R. W. Judd, treasurer. Mr. Everett succeeds E. W. Moore as vice-president.

Directors of 15 rural telephone lines covering the western half of Steuben County, N. Y., have entered into an agreement with the Century Telephone Company, whereby the rural lines will be centered in the Bath Century office, establishing connections with the toll and village lines, as well as affording communication from one rural line to another.

The Robinson Telephone Company has been incorporated with the New York Secretary of State to operate in St. Lawrence and Franklin Counties. The capital is $10,000, and directors: T. J. Robinson, of Potsdam; W. F. Robinson, of Addison, Vt., and Lindley Robinson, of Crary Mills.

The Iowa Telephone Company is planning the erection of a new exchange building in Sioux City during the coming summer. E. A. Clark, manager of the company has made the positive statement that the company, would be housed in its own exchange building by next November.

The controversy in which the Sioux City, Ia., Telephone Company, Bills Bros. and the General Engineering Company have been mixed, has been settled, and announcement is made that within 90 days the people of Sioux City will be talking over the new automatic telephones.

A new telephone system has been installed at Haskell, I. T., a new town on the Midland Valley Railroad. A toll line will be connected with Muskogee.

The Providence, R. I., Telephone Company is planning for a new telephone exchange building in East Providence.

The Glen Telephone Company is preparing to install an addition to its switchboard in Canajoharie, N. Y.

The Rural Telephone Company has obtained the right-of-way through Glassboro and Clayton, N. J.

Telephone Incorporations.

The Unity Township Telephone Association, East Palestine, O. Capital stock, $8,000. Incorporators: J. F. Johnston, M. W. Beyer, Everett L. Lyon, J. S. Kirball and J. J. Rukenbrod.

The Franklin Farmers' Co-operative Telephone Company, Farmington, Me.—to construct a telephone line, etc. Capital stock, $10,000. Officers: President, H. H. Devoe, Farmington; treasurer and clerk, F. E. Voter, Farmington.

The East-Wood Telephone Company, Elmore, O. Capital stock, $50,000. Incorporators: J. G. Steinkamp, Homer Metzgar, Taylor Fuller, Fred Windisch and George W. Luckey.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Arcanum, O.—At a recent election the people voted to issue bonds to the amount of $38,000, for building waterworks and electric light plants.

Benton Harbor, Mich.—The Michigan Cold Storage & Transfer Company will build an electric light plant with sufficient capacity to provide light for this city.

Bristol, Tenn.—This city has granted a franchise to Edward Durham, of Philadelphia, Pa., and William B. Cutler, of Buffalo, N. Y., to construct and operate an electric light plant.

Cassville, Wis.—A special election will be held March 30 to vote on the electric light question.

Centerville, Ia.—A mutual electric light company is projected and will seek a franchise at the election March 27.

Centerville, Md.—This city is to have an electric light and gas plant in the near future. D. S. Pindell, of Michigan, representing the Buner Electric Light Company, has conferred with the board of town commissioners and a contract has been signed.

Cheshire, Conn.—This town contemplates erecting an electric plant of its own. A committee, consisting of R. H. Morgan, J. M. Speake and Ira D. Woodley has been appointed to ascertain just what such a plant would cost.

Covington, Ga.—The city council contemplates re-establishing the city electric light plant, which was destroyed by an explosion.

Elkhart, Ind.—Ex-Congressman C. G. Conn's new electric light plant and hydraulic properties were damaged to the extent of several thousand dollars by a serious washout of a race bank.

Ephraim, Utah.—The city council will be requested to call a special election to vote on the issuance of bonds to the amount of $20,000 for the erection of a power and electric light plant.

Gainesville, Ark.—The Gainesville Gas & Electric Company, with a capital of $100.000, has been incorporated by Charles W. Moore. Jeremiah Cushman and others, to operate a gas and electric light plant.

Gravette, Ark.—This city contemplates constructing waterworks to cost from $8,000 to $10,000; also the establishment of an electric light plant is being considered. A. C. Veach may be addressed.

Lone Oak, Tex.—It is reported that W. L. Harrison is arranging for the installation of an electric light plant.

Lyndon, Ill.—A franchise has been granted to H. F. Breen and others to construct a dam here. An electric plant is to be built in connection at a cost of $150,000.

Marietta, O.—The county commissioners are considering the matter of installing an electric light plant at the court house.

New Franklin, Mo.—A special election has been called for March 27 to vote on a proposition to grant a franchise for an electric light plant to be erected and operated by a local company.

Onalaska, Wis.—Mr. Stinson, of West Salem, has applied to the council of this city for a franchise to furnish electric lights here.

Oolitic, Ind.—The town board has decided to build a combined waterworks and electric light plant to cost about $23,000.

Petros, Tenn.—The Big Brushy Mountain Coal & Coke Company, which recently installed an electric light plant at its mines, is arranging to furnish this town with lights. A. H. Wood, of Harriman, is president.

Red Oak, Ia.—The Electric Light Company will increase the capacity of its plant.

Rosedale, Miss.—The city council at a recent meeting appointed a committee to get prices on an electric light plant, same to be run in connection with the waterworks and owned and operated by the city.

Sodus, N. Y.—The Sodus Gas & Electric Light Company contemplates establishing an electric light plant. George L. Colgate is the engineer in charge.

Sonora, Tex.—Hurst Brothers are arranging for the establishment of an electric light plant.

Vallejo, Cal.—The California Gas & Electric Company, of this city, has succeeded the Vallejo Gas Light Company, and will expend $25,000 in improving the system here, which will be extended to every portion of the city.

Virden, Ill.—The city council has granted a 20-year franchise to C. W. Carr for the erection of an electric light plant.

West Burlington, Ia.—The citizens will vote on the question of establishing a municipal electric lighting plant.

West End, Ala.—The city council has granted an electric light franchise to the Birmingham Railway, Light & Power Company.

STREET RAILWAYS.

Auburn, N. Y.—The common council has granted to the Auburn & Northern Railroad Company, in which C. H. Beebe, of Syracuse, is interested, permission to lay tracks in Dill and other streets. This 9-mile double-track line to Port Byron will connect the Rochester, Syracuse & Eastern and the Auburn & Syracuse railroads.

Colfax, Wash.—The Whitman Electric Railway & Power Company, which is planning an electric railroad from here to Palouse, has begun grading the roadbed.

Columbia City, Ind.—The proposed electric road from here to Goshen is being surveyed.

Edwardsville, Ill.—An ordinance granting a franchise to the Edwardsville, Alton & St. Louis Railway Company has been passed by the city council of Edwardsville. The grant provides that an electric line may be built through the western part of the city, and eight miles to Mitchell.

Frankfort, Ky.—The Central Kentucky Traction Company, with $200,000 stock, a Fayette County corporation, lately filed articles with the Secretary of State.

Greenville, Tex.—J. M. Waits, representing a company of Dallas is contemplating the erection of an electric interurban trolley line from this city to Bonham.

Indianapolis, Ind.—This city will grant a franchise to the Indianapolis, Newcastle & Toledo Traction Company.

Kankakee, Ill.—The Kankakee & Western Electric Company, of this city, capitalized at $15,000, has been formed to construct electric railroads.

Little Rock, Ark.—L. Garrett has been looking over the field here with a view to building an interurban electric line between this city and Hot Springs. He has begun preparations for the organization of a company to carry the project through.

Manitowoc, Wis.—The Fox River Valley Railway Company proposes to construct an electric interurban line from Sheboygan to this city and then to Kaukauna.

Mt. Sterling, Ky.—It is reported here that the recently incorporated Olympian Springs Company, of Lexington, will build an electric car line from the Chesapeake & Ohio road to the springs and extend it into the mountains to West Liberty.

North Baltimore, O.—S. O. Douglass, of Toledo, has lately been in this section in the interest of a new trolley line from Fostoria to Deshler.

Paw Paw, Mich.—Dunkley & Williams are preparing to erect a trolley line from South Haven to Kalamazoo, to be operated in conjunction with the Dunkley-Williams steamboat line between South Haven and Chicago.

Schenectady, N.Y.—It is said that the Schenectady Railway Company expects to build a complete trolley system in Saratoga Springs.

Winona Lake, Ind.—The Winona Interurban Railway Company of this place will erect a new power house at a cost of $600,000.

POWER PLANTS.

Columbus, O.—Prof. B. F. Thomas, of the Ohio State University, has prepared plans for a new power plant to be erected at the Dayton State Hospital.

Ft. Gibson, I. T.—It is reported that a $1,000,000 plant will be built on the Grand River for the transmission of power by electricity. Surveys are being made under the supervision of D. W. Bolich, engineer.

Montgomery, Ala.—The Tallapoosa Water Power & Electric Company has been incorporated by Ausfeld & Chapman, of this city, and others The company will shortly commence the erection of its proposed plant to cost $500,000.

Mountain Home, Idaho,—J. E. Jerome, W. J. Turner and J. H. Garrett, of this place, are organizing a company with a capital of $500,000, and will build a power plant at Crane Falls for the purpose of furnishing this town and Bruneau with electric power and light.

Salt Lake City, Utah.—It is reported that the Utah Light & Railway Company contemplates constructing a power plant. R. S. Campbell is general manager of the company.

BIDS WANTED.

Baltimore, Md.—The Eastern Flint & Spar Company, 616 North Calvert street, this city, wants prices on a 100 hp. engine.

Des Moines, Ia.—Sealed bids will be received by N. B. Vertrees, city clerk, until March 31, for electrical supplies, etc.

Lincoln, Neb.—The water commissioner has been instructed to secure bids on a 75 hp. vertical alternating electric motor for use at the pumping station.

Springfield, Tenn.—Dulin, Glenn & Co., of this place, want prices on electrical equipment.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15¼@15⅜c.; casting, 14⅞@15c.

The Toledo (O.) Railway & Light Company reports for February a surplus increase of $10,858.

Orders on the books of the Electric Storage Battery Company are said to be double those at this time last year.

The belief is quite general that the Massachusetts Electric Companies will resume 4 per cent. dividends upon its preferred stock this summer.

The New York franchise tax cases will be called for April 3, for argument in the Supreme Court at Washington. The sum involved is about $21,000,000.

President Winter of the Brooklyn Rapid Transit Company says that the company has decided that an elevated loop is the only solution for the congestion of the Brooklyn bridges.

The Haverhill (Mass.) Electric Company has been authorized to issue 1,071 additional shares of stock at $160 a share for the purpose of funding the debt incurred in extensions of the plant.

An official of the Allis-Chalmers Company says the outlook for business this year is very gratifying, but no one connected with the company will attempt to discuss dividends on the stock.

For the purpose of paying the regular quarterly dividend of 1 per cent. on May 1, the tranfer books of the Detroit United Railway Company will close at noon April 15 and reopen May 2.

On June 1 there will be delivered to the Brooklyn Rapid Transit system $2,500,000 of new equipment. The delivery of this equipment will be in time for the company's heavy summer business and it should have considerable bearing upon earnings.

The Interborough Rapid Transit Company of New York has declared a quarterly dividend of 1¾ per cent. on its capital stock, payable April 4. The declaration puts the stock on a 7 per cent. basis, although it had been thought an 8 or 10 per cent. basis would be established.

The Boston & Worcester Electric Railway Company is preparing for the installation of a freight and express service upon its line. It is estimated that this will require an equipment of five cars that will cost $4,000 each. With this equipment express experts claim that the company can do a gross business of about $125,000 per annum and that it will cost about 40 per cent. of gross to get it.

The Baltimore pool which is in charge of Alexander Brown and George C. Jenkins, as trustees of the common stock of the United Railways & Electric Company of Baltimore, has closed and it is said that considerable over a majority of the stock was deposited. The agreement is for three years, and one of the provisions is that the trustees may sell the stock on terms approved by 75 per cent. of the shares deposited.

Kidder, Peabody & Co., of Boston, and Baring Bros. & Co., Limited, of London, are offering for public subscription, at 96½ and accrued interest, the balance remaining unsold of an issue of $25,000,000 American Telephone & Telegraph Company collateral 4 per cent. gold bonds, dated July 1, 1889, and maturing July 1, 1929. Subscription lists will be opened on Tuesday, March 21, at 10 A.M., and closed at or before 3 P.M. on the same date.

ELEOTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price Mar. 18
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	169¼
Metropolitan Street Railway	123¾
Metropolitan Securities	88½
Ninth Avenue	197
Third Avenue	132¾
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	67
Interborough Rapid Transit	213
New Orleans Railway	4½
Public Service Corporation (New Jersey)	141
Philadelphia.	
Consolidated Traction of New Jersey	83
Philadelphia Traction	100⅛
Union Traction	59
Boston.	
Boston Elevated	156
Massachusetts Electric Companies, com	19
do. do. do. pref.	64½
West End Street, com	97
do. do. do. pref.	115½
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	12¼
do. do. pref.	51

ELECTRIC MANUFACTURING COMPANIES' STOCKS.

Name.	Closing price Mar. 18
New York City.	
Allis-Chalmers, com	16½
do. pref.	62
Electric Boat, com	41
do. do. pref.	84½
Electric Lead Reduction	½
Electric Vehicle, com	14½
do. do. pref.	24
Westinghouse, com	181
do. pref.	192
General Electric	188⅛
Boston.	
Edison Electric Illuminating	253
General Electric	187¾
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	45
do. do. pref.	113
Philadelphia.	
Electric Company of America	12
Electric Storage Battery, com	85½
do. do. do. pref.	85½

TELEPHONE AND TELEGRAPH STOCKS.

Name.	Closing price Mar. 18
Boston.	
American Telephone & Telegraph Company	144⅜
Western Telephone Company	20½
New England Telephone Company	138
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210½
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	94½
Chicago Telephone Company	142

MISCELLANEOUS STOCKS.

Name.	Closing price Mar. 18
Otis Elevator Company	49
Consolidated Car Heating	64
Standard Underground Cable	200

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NORTON VOLTMETER
10 30 50 70 90 110 130 150
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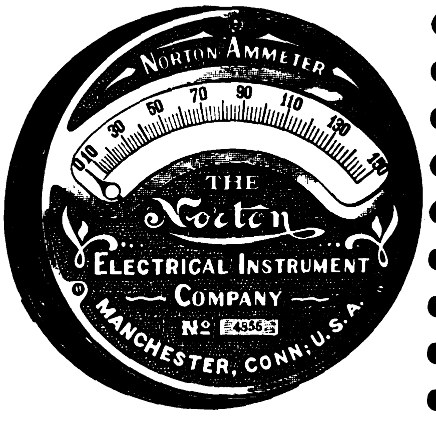
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COMPANY
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MANCHESTER, CONN. U.S.A.

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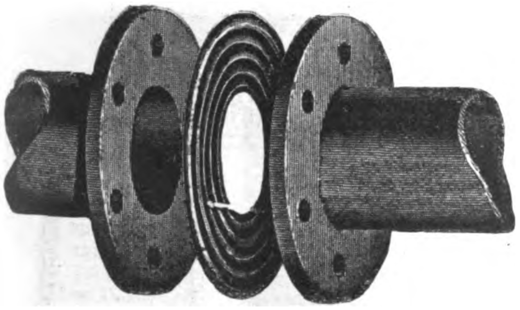

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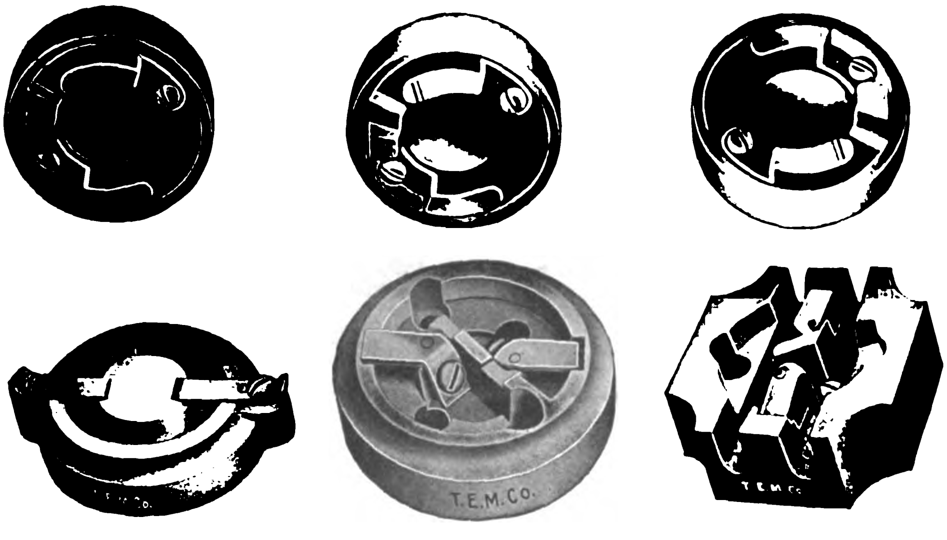
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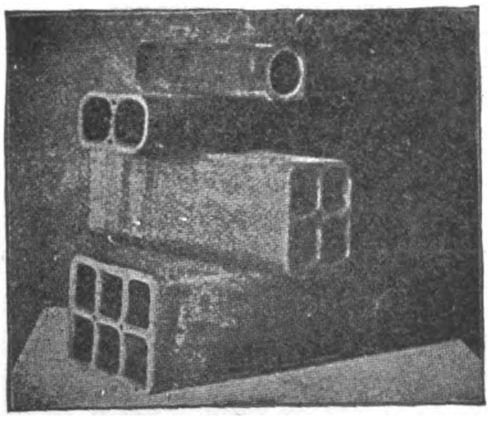

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ELECTRICITY.

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As ELECTRICITY reaches all classes interested in electrical work, its value as an advertising medium can be readily understood. Rates will be sent on application.

Changes of advertisements should reach the office not later than Saturday morning preceding the day of publication.

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EDITORIAL NOTES.

Electric Railways Across the Continent.

Reviewing present accomplishments from a general standpoint, it is evident that a distinct evolutionary process has taken place, which has been the means, although for the most part unconscious to ourselves, through which the work of the past, the success of the present, and the experiments of the future form parts of one vast chain of events in the field of electric railroading. For at least one generation, Van Depoele, Daft and Sprague struggled with the chaotic conditions confronting them. What had been accomplished was done with a certain arbitrariness, in which the success of the motor, the transmission and distribution of power, and in total, the success of the electric car as a whole were but parts of one confusing problem. Time has helped to sift these matters, aided by the genius and self-sacrifice of many workers, and it seems, as we have stated, that the subdivisions of this great task slowly came to light. The motor, the track, the trolley, the gearing and the power house with its varied equipment separated themselves into single departments of one general proposition, and thus called into being the attention of the subordinate workers with their improvements in incidentals and details. The facts settled upon related to the general equipment of the car, the horse power, trucks, speed, etc.; the installation of the tracks and overhead trolley or of the third-rail, its electrical equivalent; and, finally of the design of the station, with its engines, boilers and 500-volt generators. This, in the aggregate, represents the first chapter of this interesting history.

The next step was the introduction of alternating currents to facilitate the delivery of power with an economy which invited further extensions and greater developments. Niagara now turns the wheels of all cars in Buffalo, and wherever power is available in sufficient quantity it can be transmitted and distributed economically for electric railway, power and lighting service. This, it seems, is the second stage of the problem or the second great chapter of the new volume of electric railroading.

The third development in this field is unique. It is the crystallization of old ideas in a new enterprise, and presents some startling possibilities in the light of recent experiments. The series-wound motor has long been known to operate well with a single-phase alternating current. By laminating the iron of such a motor, it is capable of developing power with great efficiency. The application of this motor, which is practically the type of motor now employed, but supplying it with an alternating instead of a direct current for electric car service, may lead to the use of transcontinental electric lines in this country. Pressures of nearly 20,000 volts, or about 40 times that now in use, can be employed to run electric cars.

The simple equipment of the car itself, and the great saving in the station, makes it one of the most alluring propositions ever brought before a board of financiers. The sub-station, the rotary converter and a great variety of adjuncts can be entirely dispensed with. The radius of action of a street railway system alone may be enormously increased, and the first cost of installation proportionately greatly reduced.

Electric railways for trans-continental purposes can come into existence as soon as the practical pressure at which they can be worked is settled. This uncertainty is being rapidly dispelled by a systematic line of experiments by one of our largest engineering concerns. Another decade will not pass before New

York, Buffalo and Chicago are stopping places for our great electric train service, reaching far into the western slopes.

* * *

A Reduction in Telephone Rates. After years of struggle against the exorbitant rates of the New York Telephone Company relief is in sight.

The Telephone Trust in this city has seen fit to hearken to the demands of the people and announces that, beginning May 1, a new and more equitable schedule of telephone rates will go into effect. An officer of the company states that all direct line business subscribers will be charged the new schedule of rates, regardless of the rates named in the contract now existing between the subscribers and the company. These rates, which are given in detail on the telephone page of this issue of ELECTRICITY, range from 10 to 20 per cent. less than those now in force.

The reductions are supposedly made on the basis that the New York Telephone Company is willing to reduce its net earnings, so that the latter will be 10 per cent. on the capital actually invested, instead of the 14 per cent. it earned last year.

There will also be a reduction of tolls between the boroughs, those from Manhattan and the Bronx being given on page 184 of this issue.

The citizens of Greater New York should feel elated that the New York Telephone Company has at last been driven from the position it has maintained for ten years—that of a monopolistic dictator, which would not feel the force of public sentiment, and give those dependent upon it fair and equitable treatment.

* * *

The Search for Platinum. Owing to the increased demand for platinum, especially in the electrical industry, the United States Geological Survey is about to make an examination of the platinum resources of the United States. It is proposed to collect the heavy sands from all placer mines in the United States where evidences of platinum have been observed. The samples thus obtained will be used in determining the best methods of extracting the various minerals which have economic value. It is hoped that the separation and sale of these useful minerals, such as magnetite, chromite, garnet, monazite, rutile, zircon, gold, platinum, etc., will, in many places, become a permanent and profitable industry.

As a preliminary step to this investigation, the Survey invites the owners of placer deposits to contribute for examination samples of material likely to contain platinum. These samples, which should be sent by mail, must weigh not more than four pounds each. It is suggested that the gravel be concentrated before it is mailed. Careful note should be made on the package, or in a letter accompanying it, of the total quantity of original gravel which the concentrate represents, in order that an accurate idea may be obtained of the value of the gravel for the purposes under investigation. The sand should be dry when mailed and great care should be exercised to pack it securely, preferably in canvas bags, for transmission through the mails. Each package of sand should be accompanied by exact information as to the name and postoffice address of the sender, the name of the mine or claim from which it came, and the State, county, city, village or district in which the deposit is located.

After the Survey has made an examination of these samples, experts will be sent to all localities where preliminary tests give evidence of platinum. The expert will report on the size of the deposit and superintend the collection of representative samples for concentration. Experiments in the concentration of platinum sands will probably be carried on in connection with the exhibits of mining machinery at the Lewis and Clarke Centennial at Portland, Oregon, between June 1 and October 15 of this year.

Native platinum has been found most frequently in gold-bearing sands. On account of its weight it remains in the sluices with gold and other heavy material. It is most readily distinguished by the following characteristics:

(1) Its great weight. In panning it remains behind even gold in the pan.

(2) Its white color. It is whiter than lead and is distinguished from amalgam by its smooth surface, whereas the surface of amalgam as seen under a good glass is rough.

Platinum seems to be more generally distributed through California than through any other State. It has been found in Butte, Del Norte, Humboldt, Mendocino, Placer, Plumas, San Luis Obispo, Santa Barbara, Santa Cruz, Shasta, Siskiyou, Tehama, Trinity and Yuba counties. Curry, Coos, Lincoln and Josephine counties in Oregon have produced platinum. It has been discovered in Nez Perces County, Idaho.

◆

The annual convention of the American Institute of Electrical Engineers will be held at Asheville, N. C., June 19 to 23.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Mr. William Marconi sailed on Saturday from Liverpool for New York.

◆

In this issue of ELECTRICITY will be found an advertisement from the New York Civil Service Commissioners regarding the appointment of an electrician. Applications for the position will not be received after April 4.

◆

Secretary Farrand informs us that a large number of inquiries have already been received regarding hotel accommodations for delegates attending the 28th convention of the National Electric Light Association, to be held at Denver-Colorado Springs June 6-11 next. He requests that all such inquiries should be addressed to the committee on hotel arrangements, 405 17th street, Denver. The personnel of the committee includes Mr. W. J. Barker, chairman; Messrs. J. Hernan, J. J. Cooper, J. F. Vail, S. W. Cantril, H. L. Woolfenden, Philip Cross, and J. C. Andrews, secretary.

◆

Sir Oliver Lodge, principal of the University of Birmingham, according to a cable dispatch from London, lectured Friday evening on what he described as a pertinacious electrical current. Stripped of technicalities, he said it could be described as a persistent current which would overcome great obstacles and go in any direction regardless of what stood in the way. He had been looking for such a current since 1884 and had only recently encountered it. He had applied it successfully in his prolonged experiments for dispersing fogs.

◆

In a paper read before the Tramways & Light Railways Association at Birmingham, the cost of building electric railways in England was stated to be from $20,000 to $30,000 per mile.

◆

A dispatch from Worcester, Mass., says that the New Haven Railroad Company is seeking to add the Worcester Consolidated Street Railway Company to its electric traction properties. The apparent purpose of this acquisition is the building of a through trolley line from New York to Boston running parallel with the Boston & Albany out from Boston as far as Springfield, following the New Haven the rest of the way to New York. To obtain possession of the Worcester Consolidated, control of the Worcester Railways & Investment Company, which is a voluntary association formed in 1901, and which owns 35,490 shares of the Consolidated Company, must first be obtained.

AN INTERNATIONAL EXHIBITION IN ITALY.

An exhibition is to be held next year—1906—at Milan in a sense to celebrate the opening of the Simplon Tunnel to passenger traffic, and it has already been postponed for two successive years. The locality of the exhibition is one which will add much to its success as a show. It will induce the visitor to travel by a new international route, which in Italy skirts the Lake Maggiore and in Switzerland the Lake of Geneva, while a circular tour can be made in going or returning by the Gotthard Tunnel.

The "transport" section of the exhibition comprehends every form of transit by land, by water and by air. It is divided into ten principal divisions. Division No. 1 relates to roads and highways, roadmaking, paving and maintenance. Division No. 2 treats of road vehicles for horse traction, conveying passengers and goods; also miscellaneous urban transports of every kind. Division No. 3, cycles and cycling. Division No. 5, railways, is a most important section, but from which electrical transport is excluded. Like all the other divisions, it is divided into groups, subdivided into classes Division No. 6 is devoted to electrical transports. In Division No. 7 all kinds of aeronautical apparatus will be exhibited. Division 8 is devoted to different forms of telegraphy and telephony. Division 9 is given up entirely to the Simplon Tunnel and is divided into three groups. Group 1, details—scientific, historical and commercial. Group 2, plans, models, projects for the line and approach lines; publications relating thereto. Group 3, alignments, geological sections, preliminary work, preparation of the plant at either side, water power canalization, the rock borers at work, examples of timbering and of steel frames, drainage, ventilation, refrigeration, types of masonry lining. Division 10 will be retrospective and historical. It will deal by illustrations, models and antiquities with the principal roads of the world, their bridges, viaducts and tunnels; with books, prints, saddlery, etc.; with the history of cars and carriages through the ages; with railways, cycling and automobilism, and aeronautics; with telegraph, demography and so on.

The exhibition will be open from April to November, 1906. Demands for space have to be received by the Exhibition Committee before May 31, 1905.—"Engineer," London.

THE GROMO-NEMBRO POWER TRANSMISSION LINE.

BY C. SMITH.

In the northern part of Italy, in the province of Lombardy, there has recently been installed and put in operation an extremely interesting power transmission line between the cities of Gromo and Nembro. The river Serio, a mountain stream rising in the Alps, furnishes 2,000 hp. at Gromo, and can furnish 2,000 hp. more at a point farther up the stream; of this amount only the 2,000 hp. at Gromo has been developed as yet.

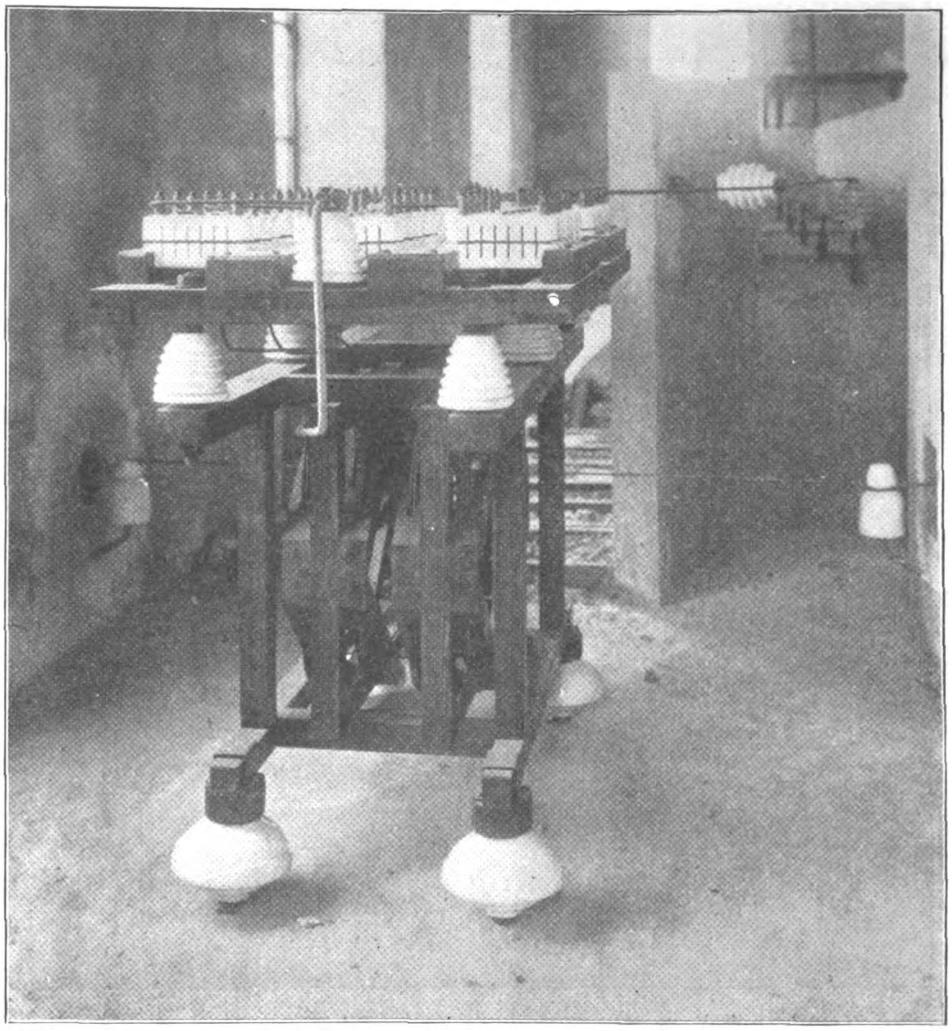
Fig. 1.—A Wurtz Lightning Arrester.

It was necessary to transmit this power to Nembro, a distance of 35 kilometers, where it would be used to drive the machinery at the cotton mills of Crespi & Co. of Milan. It was also essential that provision be made to transmit the remaining available power over a line on the same poles as the first line, which is the only one installed at present; this second line would be used to transmit the power to a greater distance. The loss in the line was to be very low, and the cost of installation was also to be reduced as much as possible.

At first it was decided to transmit the power by three-phase current at a pressure of 30,000 volts over three bare copper wires, each with a diameter of 6.5 mm., the drop on the line being approximately 4 per cent. But this plan presented, in this particular case, difficulties in the way of erecting the second line without interrupting the service of the first, and as the financial expenditure for two sets of poles would have been too great, it was imperative that the line should be designed from the start for a 4,000 hp. transmission. As the drop in the line was not to be more than 4 to 5 per cent., two plans were available, either to increase the diameter of the conductors, or to raise the tension on the line.

The second plan, however, was adopted as the additional cost was considerably less than in the case of the first plan, and it was decided to use a three-phase current at a tension of 40,000 volts for the transmission.

The power station at Gromo consists of three turbo alternator sets of 1,000 hp.

each, the third generating set being held in reserve in case of a breakdown. The alternators generate a three-phase current at a tension of 4,000 volts with a frequency of 50 periods per second. They are 12-pole machines and operate at a speed of 500 revolutions per minute, being connected to Escher-Wyss turbines.

Two exciters of 25 kilowatts each, direct coupled to turbines, are also installed and furnish a current of 217 amperes, with a pressure of 115 volts, the speed being 800 revolutions per minute. The alternators deliver the current at 4,000 volts to 850 kilowatt transformers, which raise the tension to 40,000 volts with a frequency of 50 periods per second and transmit it to the bus-bars. These oil-cooled transformers with water-cooling pipes use 18 liters of water per minute. The insulation between the primary and secondary windings has been tested at 67,000 volts.

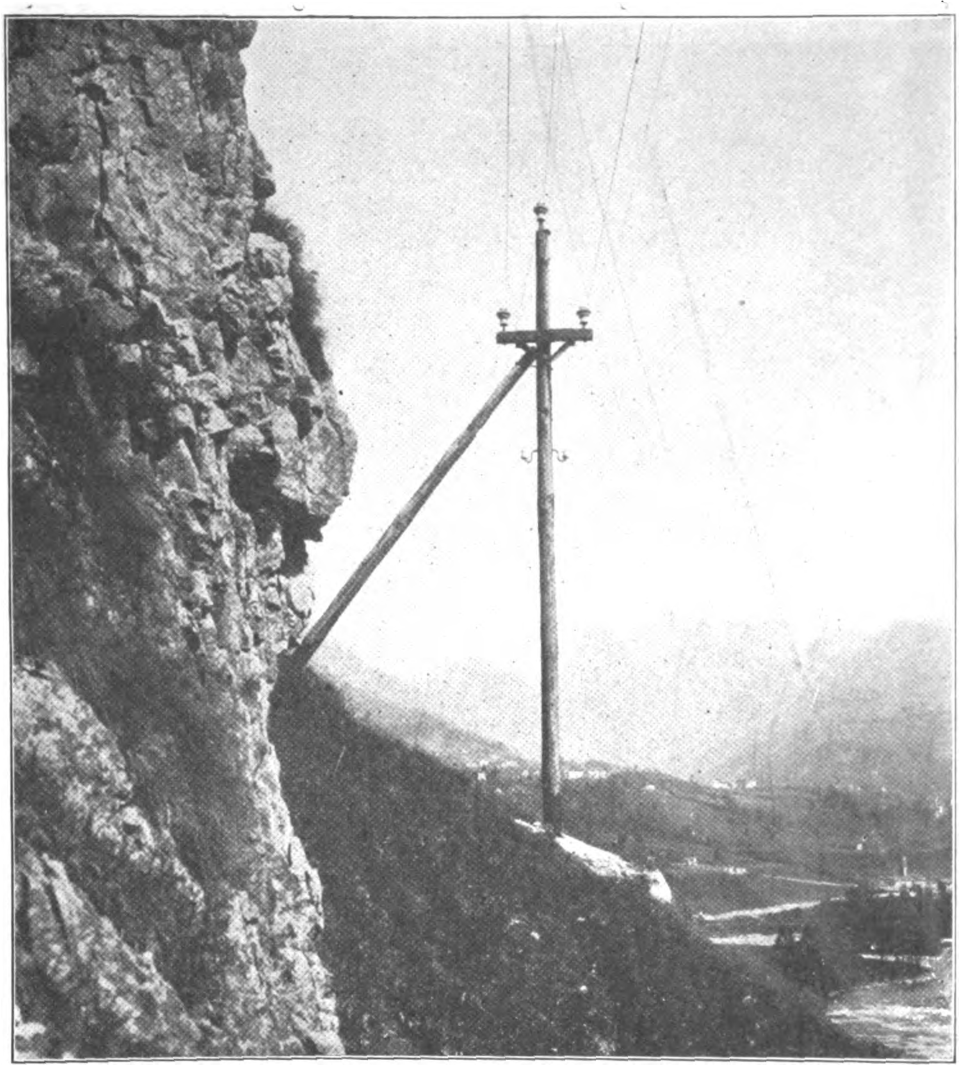

Fig. 2.—View of Power Transmission Line, Showing Use of Single Pole.

The switches as well as the transformers are located in a separate building which has three stories and a basement, the floor space being 10 by 7 meters. The basement is divided into two compartments; the first, which is 1.2 meters below the engine room floor, contains the regulating rheostats, and the second 2.7 below the level of the first floor, contains the transformers. The first floor also has two compartments, one for the switchboard and measuring instruments, the other for the high pressure automatic switches and the three transformers for the transmission line. The second floor contains the collecting bars and pressure transformers while the lightning arresters are on the third floor where the line leaves the building. These lightning arresters are of the Wurtz type, and insulated from the ground floor by porclain insulators. The care with which this is done can be seen from the illustration, Fig. 1.

The conductors, leaving the third floor through the window, are in thick glass tubes, and each wire is at least 250 mm. from all uninsulated bodies. The transmission line, which is about 32 kilometers in length, consists of three copper wires, 6.5 mm. in diameter, mounted on a new form of delta insulator designed especially for this installation. These insulators have stood a flash test of 80,000 volts.

The poles on which the insulators are mounted are 8 to 9 meters above the ground, and, as a rule, the lines are mounted on a single pole as seen in Fig. 2. Where there are sharp bends or long spans, two poles are used and the three insulators are fixed at the same height, the distance between them being 1,000 mm. while in the case of one pole, the insulators are 850 mm. apart. The poles are ordinarily 40 meters apart. The longest span is 120 meters and the largest angle is 145 degs. One and a half meters below the high tension line there are two wires, each of 3 mm. diameter, mounted on ordinary insulators, and forming the telephone line between the power house at Gromo and the sub-station at Nembro. The transmission line crosses a monophase 2,000 volt line at San Carlo, and at Albino it crosses another line and a canal.

The Nembro sub-station is a three-story building, the first and second floors being each divided into two compartments. The first floor contains the transformers, the disconnecting gear, and the secondary bus-bars as well as the current transformers. The high tension oil-switches and distributing panels are on the second floor, while the 38,000 volt bus-bars and lightning arresters are on the upper floor.

The current enters this sub-station at a tension of 38,000 volts. There is room for three 500 kilowatt three-phase transformers, but at the present time only two have been installed. They are of the same type as those at Gromo, only smaller, and reduce the tension from 38,000 volts to 500 volts. The insulation between their primary and secondary windings has been tested at 57,000 volts. The transformers have a length of 1,600 mm., a width of 1,155 mm., and a height of 2,005 mm. They require 13 liters of water per minute.

A three-pole switch mounted on poles outside the station, as seen in Fig. 3, allows the Nembro sub-station to be completely disconnected from the high tension transmission line. By means of three contacts fixed to the switch, the lines entering the station are short circuited and connected with the earth when the switch is open.

The current enters through the lightning arresters and passes to the high pressure bus-bars. It then passes through single-pole disconnectors and single-pole high tension automatic oil-switches to the transformers. The current from the secondary of the transformers passes through three-pole disconnectors and two current transformers. The transformers lead to the 500 volt distributing bus-bars.

This Gromo-Nembro power transmission line uses the highest voltage in

Europe up to the present time, and by its efficient operation during the past seven months, has shown without the possibility of a doubt the reliability and economy of high tension plants. The care with which the plant has been equipped by Brown, Boveri & Co., of Baden, Switzerland, who had this in charge, as well as the many protecting devices utilized, all combine to reduce the danger to life to a minimum.

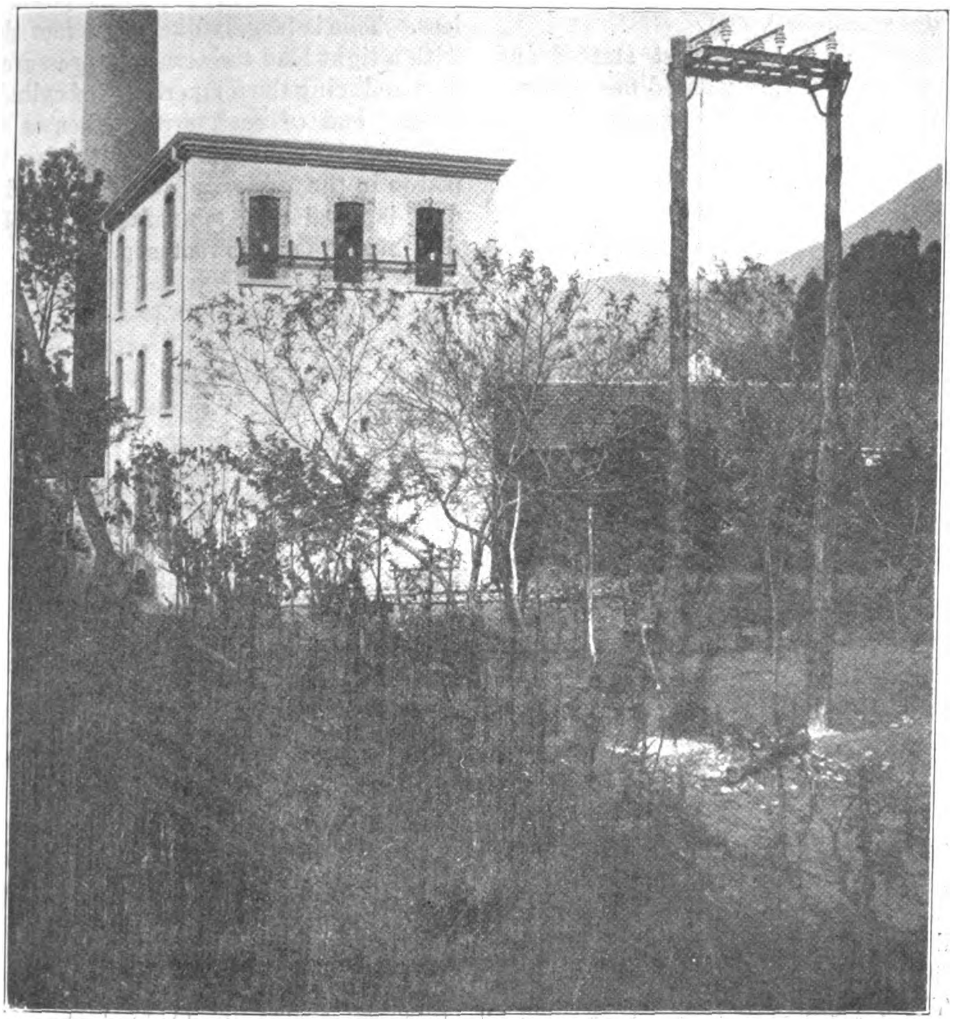

Fig. 3.—Power Transmission Line Entering the Nembro Sub-station.

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PARALLEL RUNNING OF ALTERNATORS DRIVEN BY LARGE GAS ENGINES.*

BY E. KILBURN SCOTT.

It is surprising that there should be so much misunderstanding on this matter. The writer some time ago paid a visit to Germany and Belgium, where he had an opportunity of seeing the power stations connected with the Iron and Steel Works of the Phœnix Hutte (Nurnberg engines), Oberhausen Iron and Steel Works, near Dusseldorf (Korting engines), the Ilseder Iron Works, near Peine (Oechelhaeuser engines), and the Seraing Iron and Steel Works (Cockerill engines), besides several engine makers' works.

In these stations the engines varied from 500 to 1,500 hp., and, except in the case of the last, they were all driving three-phase alternators. They were supplied by blast furnace gas in all cases, and were of the single-crank type (except the Oechelhaeuser) working with two impulses per revolution.

The Oechelhaeuser engines at the Ilseder Works were twin engines, and, owing to the peculiar double-ended construction, had three cranks to each, or six in all, to drive one alternator, an unnecessary complication.

The writer can say absolutely that there is no difficulty whatever in running three-phase generators in parallel when driven by any of the engines named. At the Oberhausen Works, for example, there were two 1,200 hp. Korting engines driving Siemens' alternators and two 600 hp. Korting engines driving A.E.G. alternators. The machines ran absolutely in parallel; and further, they were so situated that it was impossible for the man on the switchboard to see all four engines when synchronizing.

In the case of the two largest units, by looking through the poles of the alternators one got the pretty effect of seeing them apparently standing still, or slightly swinging back and forwards, as one engine gained a little on the other; this movement, however, was very slight.

It may be stated as a fact that any single-crank large gas engine by a maker of repute, in which there are two impulses on the crank per revolution, and where sufficient fly-wheel weight is allowed either in the generator wheel, or better, in the generator wheel plus a fly-wheel, parallel running is quite easy.

Of course, there are points to be remembered; one is, that the "hit-and-miss" method of governing is absolutely no use for such work; it is entirely discredited on the Continent, and Cockerill's have superseded it even for blast furnace blowing engines, where good regulation is not important.

Another point is, that the higher the speed the better is the paralleling; and yet, on the other hand, there appears to be a consensus of opinion that it is well for the engine not to run above 100 revolutions per minute on account of wear and tear.

In the actual running of these blast furnace gas engines, the only thing that seems to cause trouble is the result of using water for cleaning the gas; in some cases a certain quantity of it is carried over into the cylinder and gets deposited on the sparking plugs which have to be then taken out and dried. This is, however, a matter which can be easily rectified.

Two of the A.E.G. alternators, coupled to Nurnberg engines, were of the very neat outer pole type which enables a very heavy fly-wheel rim to be provided on the alternator wheel so that no separate fly-wheel is necessary.

All the piston rods and pistons are cooled by water, also all the exhaust valves. A spray of water playing into the exhaust pipe effectually prevents any noise or chance of firing there.

The lubrication of the cylinders is usually effected by a thick block of unrefined petroleum oil called "Mazout." All the bearings and other working parts are, of course, lubricated with ordinary mineral oil.

The engines are always started by compressed air, at about 6 atmospheres for the small engines and 9 atmospheres for engines of 1,000 hp. and upwards. They start with absolute certainty, and, usually, the gas is turned on after a few revolutions only. The writer saw a 1,000 hp. engine get up to speed from rest in two minutes.

Regarding the number of men to run the engines taking all the stations together, this appeared to run out at about a man and a quarter per engine, including the foreman. There are no young electricians or pointer dodgers in these stations, just engine runners and a switchboard attendant; the foreman appears to look after the three-phase generators in his odd moments.

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*From the "Electrical Review," London.

The work is practically identical with that of running a slow-running steam engine; indeed, some of the engines, the "Nurnberg" in particular, are surprisingly like steam engines, both in outline and detail. The spares carried are about the same as for steam engines.

The rapidity with which these engines are being adopted by the various iron and steel and other works on the Continent is very significant. Altogether the writer saw two dozen engines of over 500 hp. either running or nearing completion.

Fancy a power station, such as the one at the Ilseder Works, 240 feet long and 150 feet wide, in two spans, generating three-phase current at 10,000 volts, and transmitting it 10 miles by overhead wires to the rolling mills at Peine. I wonder what iron works in England would have the pluck to take on a job like that.

Why, the men who run these Continental works must be themselves electrical experts, for when they lay down a power station it is no half job but is undertaken with boldness and originality; no nibbling with direct current and petty little machines in a tin shed, but a tiptop first-class station worthy of a large concern.

Fifty years ago, the fathers of the men who run these works used to come to England to see engines and machinery; now the writer and many others are sent over there to report on what they are doing. And there is no mistake about it, the Germans, as a nation, are in training (in the deliberate way an athlete trains) for commercial supremacy. They have had their financial crisis and learned the lesson well.

Those amiable old folks whom one sees at Iron and Steel Institute meetings, etc., who are understood to control a fair part of what there is left of our iron and steel trade, will have to look out if they wish to retain the remainder.

Lord Kelvin's Latest Invention.

Lord Kelvin has perfected an invention which has already helped the London police considerably in their war upon the scorching motorist. It is an electrical machine for registering the time taken by a car in covering a certain distance.

PROVIDING FOR INCREASE OF POWER IN ISOLATED STATIONS.

ARTICLE II.

BY W. H. WAKEMAN.

Another plan for this purpose is shown in Fig. 2, where a high-speed engine is fitted with two flywheels and belted to two dynamos.

When the station is first started and only a few lights are wanted one dynamo can be used, then as the demand increases a second one can be put in service. When business still further improves another engine will be installed with one dynamo, and later on another dynamo will be added. This plan can be extended indefinitely.

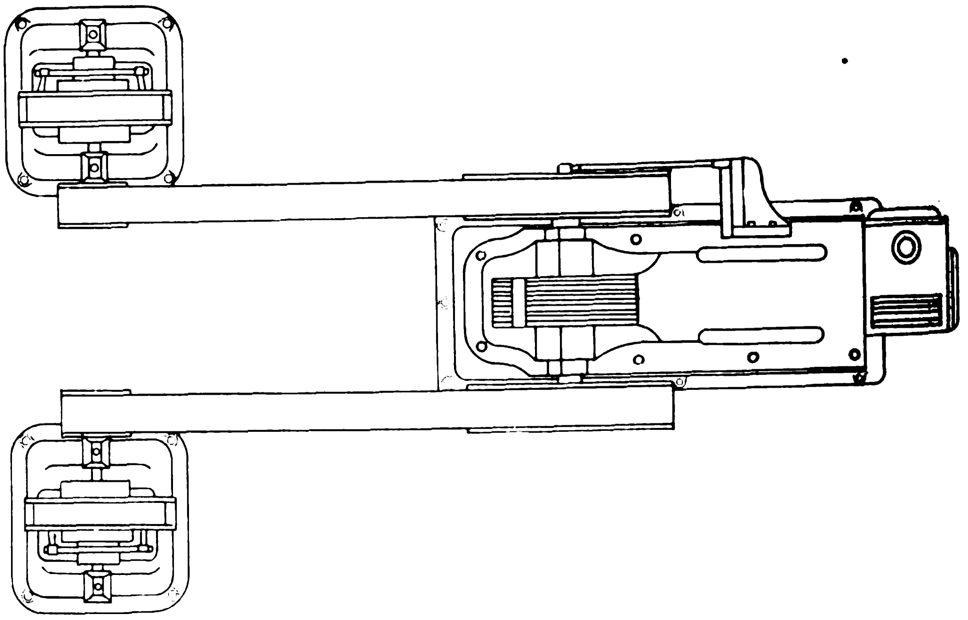

FIG. 2.

The objections to it are that when an engine that is calculated for two dynamos is driving only one it is running at a disadvantage, because it is underloaded. When I first heard or read the above statement it seemed as if it could not be true, for an engine runs so much better with a medium load, so far as "wear and tear" are concerned, that it appeared to be the best conditions for active service, but when we calculate the amount of coal required to produce one horse power for an hour, in a mill or shop, or per kilowatt hour in an electric station, under these conditions we find it more than good practice calls for.

Of course this condition of affairs cannot always be charged to one thing, as several unfavorable conditions may combine to produce the undesirable result, but where two engines are made alike, supplied with steam from the same boiler, and run the same in every way except that one of them is loaded so that its terminal pressure is about five pounds above atmospheric pressure, while in the other the expansion line crosses the atmospheric line at about one-half stroke, the former is far more economical than the latter.

More steam is required for a heavier load, but more power is developed than the direct increase of steam used calls for, therefore the amount per horse power is less. This is largely due to the fact that with a light load the terminal pressure is low, reducing the temperature of cylinder at the end of each stroke, then as the next charge of steam enters to drive the piston in the opposite direction its first duty is to raise the temperature of cylinder; but this means that some of the incoming steam is condensed in the process and is therefore a dead loss. As this is repeated twice for every revolution it seriously affects the consumption of steam.

With the direct connected generator, discussed in the previous article, the disadvantages of a high speed engine are found, but a low speed generator partially offsets these bad points. Where the belted generator, shown in Fig. 2, is used, a high speed engine is combined with a high speed generator, thus giving the bad points of both, so far as excessive friction resulting in rapid wear is concerned.

It is only fair to say, however, that these objections are almost eliminated in modern up-to-date machines, for ring and chain oilers have done much to reduce friction by providing copious and continuous lubrication, while engine builders have profited by past experience and given us engines that can be run continuously, or at least for several days, without shutting down. However, these high speed engines have not proved as economical as those of medium speed, especially after they have been used a few years.

One objection to the purchase and use of second-hand machinery is that although it may be in a fair state of preservation it does not always contain modern improvements, and lack of these features may have been one of the principal reasons for discarding it originally, therefore a practical man should decide on its merits before it is purchased.

One advantage of an outfit of this kind, composed of several small units, is that if a dynamo or an engine needs repairs, it does not disable the whole station as the other units can be run until repairs are completed.

On the other hand, it can be laid down as a general principle that the danger of accident increases directly with the number of parts in use. While this is true the objection as a whole is not so great as it was a few years ago for the same capacity of station, because improvements have made this class of machinery practically safe from sudden failure, provided it is well cared for.

It requires more men to operate a station containing high speed engines and belted generators than any other kind and when more engines are added, and the chief engineer calls for more help on this account, he should be supplied at once, for although one assistant engineer and one fireman can attend to the details of several engines and boilers it is not a good plan to overload the men any more than it is wise to overload the machinery.

CHIMNEYS.*

BY F. H. DAVIES.

As the efficient working of a natural-draught steam-raising plant is dependent greatly upon the manner in which its chimney has been designed, it follows that too much attention cannot be paid to the various minutiæ of the subject. Undoubtedly many steam installations are severely handicapped by unsuitable chimneys that, either through a false idea of economy or ignorance of the fundamental laws governing the generation of a draught, have been made too small, or are in some other way incapable of performing the necessary amount of duty. As the function of a chimney is two-fold, namely, the creation of a draught and the carrying off of the gaseous products of combustion, it must be considered under both heads, the first of which requires height and the second area. Several formulæ have been given for determining these two fundamental measurements, but as the problem is beset by many difficulties that vary considerably with local conditions, they are all of a somewhat empirical nature, being based upon observations of successful work.

The intensity of draught is dependent upon the difference in weight of the internal column of air and an imaginary external one of the same height and equal in diameter to the former at its smallest cross-section. The higher the chimney, therefore, the greater will be the force of its draught. This is measured in inches of water by the aid of a U tube, one end of which is left open to the atmosphere and the other connected to the interior of the chimney at its base. The difference in level of the water in these two legs shows the strength of the draught, which is found in practice to vary between ¼ inch, indicating a rather poor draught, up to 1 inch or over, equivalent to a very strong one. A usual formula for finding the theoretical draught in inches of water when the height is given is the following:

$$7.6\,H \times \frac{T_2 - T_1}{T_2 \times T_1};$$ H being the height in feet, T_1 the absolute temperature of the atmosphere, and T_2 the absolute temperature of the chimney gases. The result will be the required figure in inches of water. In designing a chimney it is usual to fix the height more or less arbitrarily, basing it upon previous practice, and with this quantity known it becomes easy to calculate the area from one of the usual formulæ. That due to Kent is very commonly used and is as follows:

$$A = \frac{.06\,F}{\sqrt{H}};$$ where A = actual area in square feet, H = height in feet, F = pounds of coal per hour that will be consumed. From this it is obvious that the quality of coal is a factor to be taken into consideration, as the value of F will vary with it for any given load; hence, for safety, a chimney should be designed to deal with the worst coal that is ever likely to be burnt in the furnaces. There must be, of course, a certain amount of friction between the escaping gases and the lining of the chimney, and this has been estimated to result in a layer of gas approximately 2 inches thick adhering to the sides, and therefore appreciably reducing the effective area to a value below that of the actual area. The formula $E\,A = A - 0.6\sqrt{A}$ is used for determining the effective area, A, the actual area in square feet having been found as above. Another formula is that due to Christie. It is handy for determining the maximum horse power of plant that any given chimney is capable of providing draught for, and is based upon the assumption that 4 pounds of coal are consumed per horse power hour. Using the same notation as previously it is as follows: $H.P = 3.24\,A\sqrt{H}$.

It is common knowledge that a draught that will suffice for the proper combustion of one kind of coal may be quite inadequate for another; hence it follows that the sort of coal most likely to be used enters into the question of height as well as that of area. Good bituminous coal requires the least draught, and therefore the lowest chimney, and small anthracite may be taken as the other extreme. Nothing under 70 feet in height is of much value with natural draught, even for a small plant burning the best bituminous coal, and it is better by far to err upon the side of unnecessary height as this allows more scope for forcing and in the variety of coal that may be used.

In the actual shape and building details of the chimney there is much to be considered. The nature of the materials of which it is to be composed, either brickwork or steel, its foundations, shape, stability as regards wind pressure, and other details, all of great interest and importance, enter into the question. In this country the brick chimney is by far the commonest, but in America both the stayed and self-supporting steel type are very much in vogue. They are each cheaper than a brick chimney in capital cost but having to be repainted once a year to save deterioration through corrosion add an amount to maintenance that in small plants is somewhat heavy and disproportionate. A well built brick chimney requires no repairs for years, and then only such as are of a trifling nature; consequently, it is preferred by many despite its capital cost and the fact that the steel shaft is slightly more efficient, owing to the entire absence of the leakage that is always going on through the pores of bricks and mortar. If, however, considerations of capital cost must outweigh those of revenue, the firebrick-lined steel chimney is the thing; the unlined variety need not be considered, as owing to radiation it is inefficient in the extreme.

There are two kinds of these stacks, self-supporting and stayed; the former is preferable from the point of view of appearance, and is, indeed, the only type that can be used for large work owing to staying difficulties, but it costs rather more than the latter variety, having to be much more substantial in every way. The stayed form is generally used in small power plants, being very cheap as compared with a brick shaft, and giving equally as good results if brick lined. It is built of iron or steel in cylindrical sections, which are usually lapped and riveted, although sometimes butted with a covering piece riveted on. The foot of the chimney is bolted to a heavy ring placed upon a substantial brick base, generally as high as the building, and this forms the first stage of the shaft. Wire guy ropes, usually four in number, are taken off some three-quarters of the way up by means of a ring provided with hooks or suitable attachments and fastened through turnbuckles to bolts sunk well into the building structure.

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*From the "Electrical Engineer," London.

The design of a brick chimney is a much more complicated matter than that of its steel prototype, for here various external and internal shapes are possible, whereas the cylindrical is the only form that the latter can be adapted to. Although, perhaps, the hexagonal chimney presents the most pleasing appearance, for a given area it has a smaller capacity than a circular one, and in addition exposes more surface to the overturning power of the wind. It is not, however, so bad in either of these respects as the square chimney, the internal corners of which introduce considerable resistance to the outflowing gases, and the flat external faces a comparatively large area to be acted on by the wind. This overturning force is naturally one that has to be taken into full consideration, and with a given wind pressure it will, of course, vary with the shape of the shaft, whether round, hexagonal or square. For this reason a certain relation must exist between the height, width, shape and weight of a chimney; and given these three former the latter may be found by the following formula: Where C = a constant for the various shapes—28 in the case of round, 35 octagonal, and 56 for a square chimney—H = height in feet, D = average diameter, B = breadth of base and W = weight in pounds,

$$W = C\frac{D\,H^2}{B}.$$

The proper proportioning of the foundations of a shaft is of the greatest importance, as its future welfare largely depends upon this. All proceedings must be based upon a thorough knowledge of the bearing power of the soil, which varies much with its nature. Usual practice defines the safe weight per square foot at one ton for soft clay and two tons for stiff clay or lightly packed sand; but if the soil is at all marshy efficient piling must be resorted to.

The external diameter at the base of a brick chimney should not be less than one-tenth of its height and the batter or taper usually allowed is from $\frac{1}{16}$ inch to ¼ inch on each side. The internal diameter should not vary appreciably from base to top, and the firebrick lining that is always provided is built up straight with no batter, thus leaving an air space between it and the outside wall. This lining generally extends from two-thirds to three-quarters of the total height, although in cases it is carried to the top. In the event of two flues entering a chimney at different sides, it is always desirable to build a feather or mid-wall between them to about a quarter of the height so that the gases from each have a separate path to start with. If this is not done, they are liable to baffle each other as they emerge from the flues and this may cause a considerable diminution in the efficiency of the chimney.

The usual thicknesses for the outer shell of a brick shaft are as follows: Shaft up to 3 feet internal diameter at top—4 inches for first 10 feet downwards, after this an increase of 4 inches at every 25 feet; shaft over 3 feet and not more than 5 feet internal diameter at top—8 inches to start with, increasing by 4 inches for every 25 feet downwards; shaft over 5 feet internal diameter at top—12 inches to start with, and same increase. The inner firebrick lining may be 4 inches thick for the first 20 feet or so, increasing by 4 inches at every 10 feet downwards.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

ELECTRIC RAILWAYS.

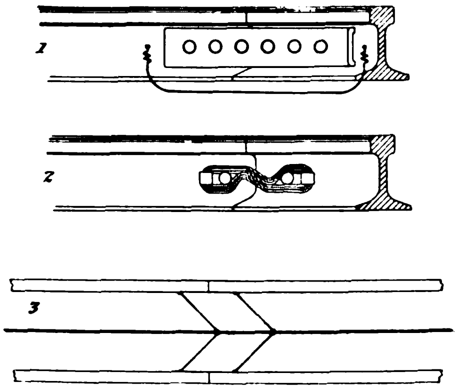
The Overhead Trolley.—The cars in this system are fed with current from the trolley wire and tracks. The trolley or pole ends in a trolley wheel which presses against the trolley wire and completes the circuit. The trolley wire of No. 0 size Brown & Sharp gauge, is supported above the track by means of wires and poles which hold it over the middle of the track. The rails are electrically continuous by means of copper bonds which join adjacent ends. Both trolley wire and tracks are reinforced at intervals by means of additional supply wires called feeders. The current enters at the trolley wheel, passes down the trolley and enters the motors via the controller. The name controller is obviously the best that could be chosen, because by means of this device the current supply is controlled and the speed and power of the motors properly regulated. The pressure employed for trolley car service is 500 volts. It is not supposed to be of sufficient strength to destroy human life, although many instances have been recorded of such unfortunate circumstances.

The Trolley Wire.—The trolley wire is made of hard drawn copper and the wires stretched across the track from pole to pole are called *span* wires. The trolley wire is also supported from brackets attached to or forming part of the posts, which are partly or wholly of metal. The construction in this respect must be such that the trolley wire, though firmly held is still elastic, otherwise the pressure of innumerable trolley poles would eventually bend it out of shape. At various points along the trolley line, where the traffic is heaviest, the wire is connected to feeders. It is also connected to feeders at those portions of the system furthest removed from the power house. These more or less distant points do not suffer so much from heavy traffic as from the effects of heavy drop. As each car takes from 50 to 150 amperes, depending upon its load and speed, and the resistance of a few miles of wire, however large in size, is quite an item, it becomes evident that the degree of drop, the product of this resistance and the current of whatever cars may be taking energy at this comparatively distant point, will be quite a percentage of the total pressure. This would cause the cars to run slow for two reasons—first, the pressure is low, and, second, the current is less because the pressure is low. The series motor is controlled, as regards its pull and speed, by just such conditions as those described, which can be incorporated into the general statement that where series motors are concerned the following is true:

Rules for Series Motors.—1. In a series motor the pull increases if the current increases and the pull decreases if the current decreases. 2. In a series motor the speed increases if the volts at its armature terminals increase, and its speed decreases if the volts at its armature terminals decrease.

Continuing the argument with respect to drop in the trolley wire, suppose six miles of this wire are considered of an average resistance of ½ an ohm to the mile, this would give a total resistance of 3 ohms. If one or two cars are consuming about 150 amperes at this point, the drop in the line before the energy is consumed equals 3 × 150 = 450 volts. It is easy to realize how completely a trolley system would fail under these conditions. In fact, a dozen cars would be the means of causing so complete a drop that practically no available energy would reach this distant point. It would be no exaggeration of the truth to state that in a large cosmopolis a trolley system represents an impossibility unless hundreds of tons of copper in the capacity of feeders are employed to carry current all along its circuit. The trolley wire, therefore, is not actually carrying the electrical energy, but its feeders. The problem is one of reducing drop to a certain practical minimum, which involves one of the heaviest investments on the part of the company. If, for instance, it takes 1,000 pounds of copper feeders to reduce the drop 1 per cent., it follows as a mathematical certainty that it will take 2,000, 3,000, 4,000 or 5,000 pounds of feeders to reduce the drop 2, 3, 4 or 5 per cent.

Bonding.—The reasoning which applies to the trolley wire of a street railway system also applies to a large extent to the tracks or rails as well. The difficulties here were originally found in the bonding of the rails. All that is required in ordinary railroad practice is to firmly secure the rails together mechanically by means of fish plates. A method of joining track lengths together such as this is mechanically good but electrically bad. Rust soon prevents a good contact from existing and the result is a high resistance joint. A series of such defects would rapidly use up the pressure when a heavy current is required, consequently an electrical contact is secured by means of bonding. To bond the rails means to establish connection between them by means of a heavy flexible copper wire or cable. The ends of this wire or stranded cable are riveted into the rail, the rivet and joint being proportioned with respect to the current which passes. It is here that the weak spot in trolley systems manifests itself, as subsequent facts will show. The rails when bonded represent two long lines of electrical conductors upon which the wheels turn and also establish the circuit through the motors from the overhead trolley wire.



1—Fishplate and bond wire. 2—Bond wire. 3—Bonding to a middle wire.

Another method of bonding is to run a wire or cable along the middle of the track and attach wires to it from the rails. In other instances the wire laid between the tracks zigzags from rail length to rail length and establishes connection. Whatever the method may be the most ideal is that employed by welding the tracks into one continuous track. Track or rail welding is the most satisfactory in the end for all the reasons which appeal to the electrical expert. The other methods though good are subject to conditions which eventually destroy their integrity. If the resistance at any one bonding averages up $\frac{1}{100}$ of an ohm, then 1,000 bonds give a resistance of 10 ohms. As this is duplicated on the other track as well, and as this track is in multiple, the net resistance would be 5 ohms. Reducing the average resistance of any one bond will still give for the aggregate resistance a very high figure. The difficulty lies in the fact that bonding steadily depreciates in quality, due to the saline matter in the streets and the by-products of the earth itself. Iron and copper form a voltaic couple, which helps to increase the bad effects of general corrosion due to ordinary causes. A current of 1,000 amperes given up by the line at any particular spot, due to a block of cars causing the almost simultaneous starting of a group of them, would cause a very heavy line drop unless the resistance is exceedingly low. It is readily seen that a resistance of $\frac{1}{10}$ of an ohm means a drop of $\frac{1}{10} \times 1{,}000 = 100$ volts. On a 500 volt circuit this means a waste of 20 per cent. of the total energy.

Electrolysis and Bad Bonding.—The energy which is not conducted through the tracks will pass through all the available gas and water pipes in the neighborhood. The statement found in Ohm's law, that the current is directly proportional to the E.M.F. and inversely proportional to the resistance, explains why the current will leak away from the tracks whenever the bonding is bad and take into its circuit water and gas mains. In passing from one to the other of these the moist earth acts as the electrolyte and the pipes as the electrodes of an electrolytic cell. The metal is carried from point to point from the outer walls of the pipes as shown by the deep pitting which results. Thus the effects of poor bonding are manifested in two ways:

First—Loss of power.

Second—Electrolysis.

In very wet weather these results are exaggerated and the general leakage throughout the systems rises to very high figures. But the two most readily controlled losses are those found in a poorly fed trolley wire and a badly bonded track.

The Controller.—The controller has been simplified in the last 10 years until it has reached a point which approximates perfection. The car motors are designed with reference to the speed of the car, its weight and acceleration; the controller is designed with reference to the starting and stopping of the car, the current consumption and the control of the circuits. If two series motors are considered, it is readily realized that the sudden throwing on of the power would result in probable accidents to those on board the car. The suddenness with which the car will start is largely dependent upon the current passing through the motors. If they are at rest and it is fully turned on, aside from the action of automatic circuit breakers, it is evident that with no back electromotive force, an enormous current would tend to flow. This would start the car with a jerk and, of course, would not be tolerated in any case. The current governs the pull of the motor, therefore to avoid too rapid a development of torque the current must be introduced to the motors through the medium of resistance. A variety of connections must be made and unmade, so as to rapidly bring the motors from a condition of rest to one of rapid motion. If in the first process a resistance is interposed, at the last process of all both motors are in multiple across the circuit. Between these two extremes of a small starting current and direct and uncontrolled consumption from the circuit exists a series of important combinations as follows:

MOTORS IN SERIES.

1—Motors in series with a resistance and with each other.

2—Motors in series with less resistance and with each other.

3—Motors in series with still less resistance and with each other.

4—Motors in series with each other (no resistance in).

5—Motors in series with each other and fields shunted.

MOTORS IN PARALLEL.

6—Motors in parallel with each other and resistance in.

7—Motors in parallel with each other and less resistance in.

8—Motors in parallel with each other and still less resistance in.

9—Motors in parallel with each other and no resistance in and fields shunted.

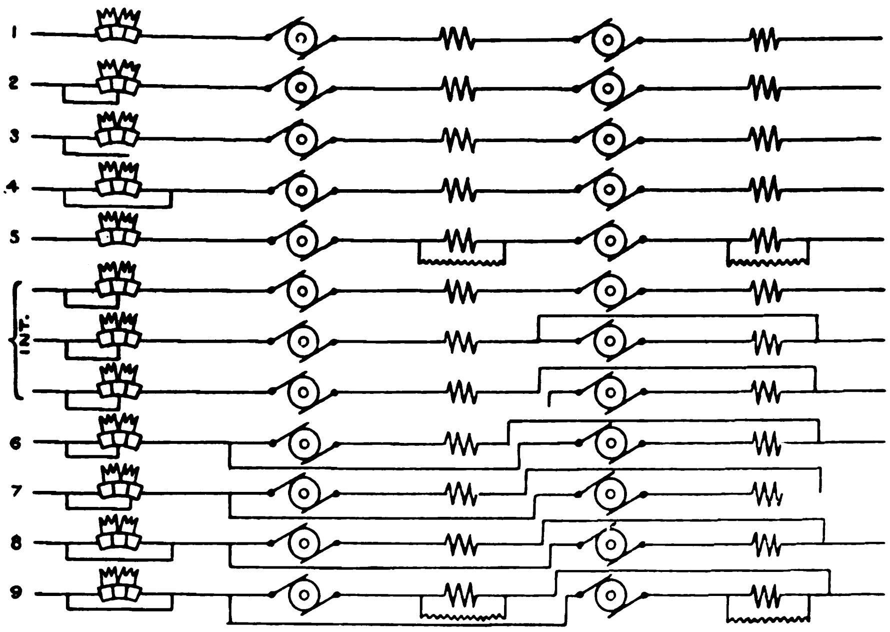
These combinations are the ones affected by the General Electric K2 street car controller. As can be seen from the description given in conjunction with the combinations it is of the series parallel type. There are really a series of combinations produced between 5 and 6 which are called intermediate connections These are the connections which throw the motors from series into parallel. The equivalent of these combinations are given in diagrammatic form in the sketch and represent the foundation on which is built the controller largely employed in Manhattan Borough, Greater New York, for street car, elevated and subway service. In looking over the series of diagrams given it will be noted that combinations 1, 2, 3, 6 and 7 call for the use of the rheostat, while combinations 4, 5, 8 and 9 do not; therefore the former must never be used for any great length of time to run the car, while the latter are allowable. It is obviously wasteful to run a car with resistance in series, and this rule applies also to the intermediate positions lying between 5 and 6, which are cases where the rheostat is in circuit. The diagram showing the general motor connections, including the controller contacts, shows the position of the various switches and cut-outs. The development of the reversing switch is also shown, the movement of which to the right or left reverses the direction of rotation of the motors and hence of the car itself. The general principle underlying these connections is that of gradually increasing the volume of current passing through the motors. From position No. 1 to No. 9 this idea is systematically carried out from having fields, armatures and resistances in series in the first case to having fields and armatures in parallel with no resistance in the last case. Thus, the engineering requirements, which are nothing more than the scientific requirements, are satisfied. The conditions in general being these, that

First—The pressure along the system both in the tracks and trolley wire is sustained by means of feeders.

Second—The current is introduced in ever-increasing value by means of the controller.

With a uniform pressure along the line the speed will not drop, with a uniform type of motor and with a scientifically constructed controller the ultimate motor torque will always be at a high figure, these two securing the valued features of electric street railways, good speed all along the line and comfortable and economical acceleration.

1



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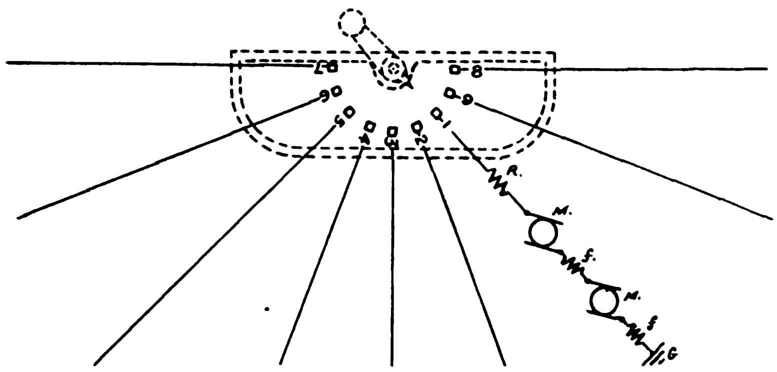

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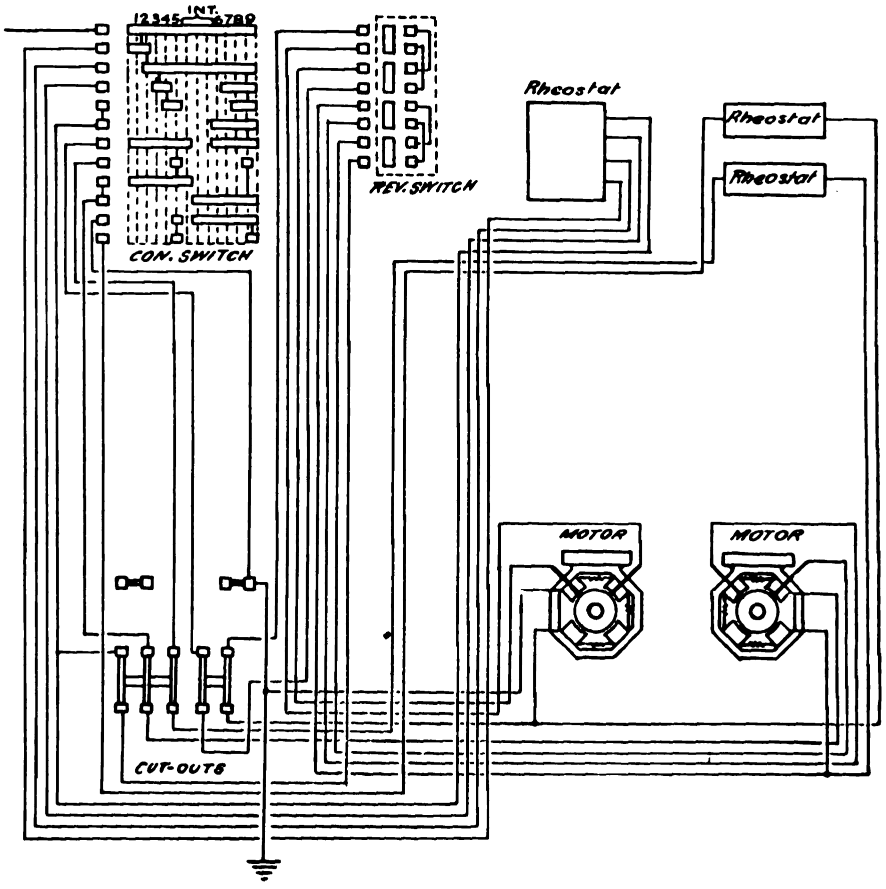

1—The motor circuits thrown into series and parallel and intermediate connections. 2—How the controller arranges the motor circuits. 3—The circuits leading to the controller in a street car.

Lecture to Engineering Students.

On Friday afternoon, March 17, Mr. Chas. E. Downton of Pittsburg gave a very interesting lecture before the engineering students of the University of Minnesota, describing the works of the Westinghouse Electric & Manufacturing Company. With the aid of a moving picture machine, he took his audience from the union depot in Pittsburg along the Pennsylvania Railway past the various factories of the Westinghouse companies, thence through several shops of the electric factory, showing the numerous steps in the construction and testing of electrical machinery. Of particular interest were several series of views showing heavy work in progress in the forge shop and foundry. The audience was much impressed by the magnitude of the works and by the long lines of employes leaving the factory and taking the trains, some 12,000 employes being engaged.

HIGH PRESSURE LINE CONSTRUCTION FOR ALTERNATING CURRENT RAILWAYS.

BY THEODORE VARNEY.

Abstract.

A paper was read at the 195th meeting of the American Institute of Electrical Engineers, March 24, treating of the above subject with particular reference to the details of construction involved. The writer, Mr. Varney, shows how advantageous the alternating current becomes in street railway service by the possibilities of high pressure, provided a good alternating current motor is at hand. The overhead trolley is the only means of using pressures of 3,000, 6,000 or 10,000 volts in contrast with the third rail for the obvious reasons of insulation and safety. The author advocates a system of substantial construction in which the use of thousands of volts will not militate against the longevity or durability of the installation. The present steam roads, if electrified, would call for the most solid and substantial class of work to insure their permanent operation. The lighter interurban roads, however, are not bound down to such emphasized substantiality. The cost of equipment in this case would not be very heavy as compared with the former. The author then enters into a description of the bracket arm, cross span and bridge construction for the high-tension purposes in view.

The important feature of the bracket arm construction is the insulator of corrugated porcelain, cemented to a malleable iron sleeve which in turn is slipped over the bracket arm and held by clamps and set screws. This insulator has a groove at its center fitted with an iron collar. The iron collar has an eye to which the messenger wire or steel supporting cable is attached by means of a hook. From the messenger wire the trolley wire is permanently supported by means of clips or hangers. The author states that unless the trolley wire as a whole is so supported that vibration to any considerable extent is checked waves or ripples will pass through it, the effect of which is to lift the wire from the trolley as it passes and thus cause arcing. This is particularly true in the case of a too rigidly supported line. The trolley line is supported at intervals of 10 feet, thus preventing the broken ends of the wire, if it should break, from touching the ground.

The hanger employed, according to the author, consisted of a galvanized malleable iron casting made in ten lengths. It was fitted with a bolted clamp to take the messenger cable and was secured to the trolley with screws. The effect of temperature upon the spans was recorded for a series of cases where the spans were 96 feet and 120 feet and the data obtained showed a change in height of about ½ and 2 inches respectively, at about 37 degs. F.

The care and thought betrayed by the author in his consideration of the requirements of substantial support and insulation to the trolley wire, are evidences of the highest appreciation of the serious nature of the problem involved.

For instance, he states that with a (0000) grooved trolley wire and hangers spaced 10 feet, the average load per foot on each cable is 1.43 lbs., and with a vertical sag of 2.7 feet, the tension is 6,000 pounds. In rough weather climatic conditions, such as wind and sleet, will raise this tension to double this figure. The breaking strain of the cables employed was above 40,000 pounds, thus preserving a large enough safety factor as far as strength is concerned, to meet all ordinary emergencies. The author states as follows: Regarding the efficiency of the insulation employed, it may be stated that under the snow-clad conditions (as described), the 2,500 feet of iron bridge work and five miles of single catenary construction showed under test a leakage of one ampere at 6,000 volts.

In conclusion the author states how the attempt has been made, which seems so far to be successful, to develop a system of overhead conductors for moderate and heavy traction service, which would approach the reliability and permanency of steam railroad equipments. In Indiana 40 miles of road have been in successful running order since the beginning of the year at a working pressure of 3,300 volts. About 60 more miles of road will be completed in the near future. The author speaks of the air-operated sliding bow trolley, a type of which he shows insulated, to stand a pressure of 6,000 volts.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MARCH 21, 1905.

Electric Railways and Appliances.

785,183. Overhead Trolley. Frank J. Prue, Woonsocket, R. I. Filed Nov. 7, 1904.

785,293. Electric Tramway. Alfredo Diatto, Turin, Italy. Filed Sept. 30, 1902.

785,294. Railway-Signal. Philip S. Dorion, Troy, N. Y., assignor of one-half to Charles B. McMurray, same place. Filed April 23, 1904.

785,315. Electric Railway. Timothy Mahoney, San Francisco, Cal. Filed Dec. 1, 1903.

785,372. Trolley-Head. Eugene J. Parker and Louis N. Colwell, Providence, R. I. Filed April 27, 1904.

785,482. Fender. Raffaela D'Oronzio, New York City. Filed Dec. 7, 1904.

785,490. Trolley Mail-Box. Wallie Hills, Kansas City, Kan. Filed Nov. 29, 1904.

785,598. Trolley. Clemens Dillhoff and Joseph Hastreiter, Morgantown, W. Va. Filed Dec. 13, 1904.

785,657. Insulated Step-Joint. Bancroft G. Braine, New York City, assignor to the Continuous Rail Joint Company of America. Filed Feb. 10, 1904.

Electric Lights and Appliances.

785,481. Portable Electric Lamp. Henry D'Olier, Jr., Philadelphia, Pa. Filed Sept. 30, 1904.

785,483. Incandescent-Lamp Holder. Jonas Feighner, Shelby, O. Filed Sept. 23, 1904.

785,516. Electric-Arc Lamp. Charles Oliver, Woolwich, Eng. Filed Feb. 29, 1904.

785,626. Socket for Electric Lamps. James A. Mebane, South Boston, Va. Filed April 30, 1904.

Electrical Machinery and Apparatus

785,306. Electrical Fuse-Box. Gilbert W. Goodridge, Bridgeport, Conn., assignor to the Bryant Electric Company, same place. Filed June 16, 1904.

785,379. Electric Welding Machine. Adolph F. Rietzel, Lynn, Mass., assignor to the Thomson Electric Welding Company, same place. Filed Nov. 16, 1903.

785,405. Electrical Switch. Robert G. Clark, Brooklyn, N. Y., assignor of one-half to U. L. Laughlin, Schenectady, N. Y. Filed April 16 1904.

785,419. Electric Switch. David E. Gray, New York City. Filed June 6, 1904.

785,487. Regulator for Alternating Currents. Edward L. Haney, Nashville, Tenn. Filed Sept. 3, 1904.

785,499. Electric Generator. William Kaisling, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed July 20, 1903.

785,532-533. Synchronous Motor and Two-Speed Winding for Three-phase Motors. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 12 and 13, 1904.

Telephones and Telephone Apparatus.

785,103. Telephone Selecting Mechanism. John P. Jackson, Orleans, Ind. Filed June 30 1903.

785,673-674. Telephone System. Isidor Kitsee, Philadelphia, Pa. Original application filed Feb. 24, 1902. Divided and last application filed Aug. 4, 1902.

Miscellaneous.

785,076. Printing-Telegraph. John C. Barclay, New York City. Filed March 1, 1904.

785,276. System of Wireless Telegraphy with Tuned Microphone-Receivers. Adolf Slaby, Charlottenburg, and Georg G. Arco, Berlin, Germany. Filed Sept. 27, 1901.

785,297. Gas-Separator for Storage Batteries. Thomas A. Edison, Orange, N. J., assignor to the Edison Storage Battery Company, same place. Filed Aug. 16, 1904.

785,316-317. Production of Sound-Records and Sound-Record. George A. Manwaring, Bayonne, and Victor H. Emerson, Newark, N. J., Eugene E. Norton, Nichols, Conn., and Frank L. Capps, London Eng., assignors to the American Graphophone Company, Bridgeport, Conn. Original application filed April 14, 1904. Divided and last application filed Oct. 4, 1904.

785,338. Means for Progressively Establishing and Dissolving Spheres of Magnetic Influence. Guion Thompson ond Huntington W. Merchant, New York City, assignors to the Thompson Safety Appliance Company, Jersey City, N. J. Filed Aug. 17, 1903.

785,366. Vacuum-Electrode. Robert Machlett, New York City. Filed Dec. 1, 1904.

785,403. System for the Rectification of Alternating Currents. Charles F. Burgess, Madison, Wis. Filed Aug. 15, 1903.

785,445. Bridging Circuits for Electric Circuits. Guion Thompson, Duluth, Minn., assignor to the Thompson Safety Appliance Company. Filed Aug. 2, 1902.

785,446. Electromagnetic Block System. Guion Thompson, Duluth, Minn., assignor to the Thompson Safety Appliance Company. Filed May 16, 1901.

THE TELEPHONE WORLD.

Cut in Telephone Rates.

U. N. Bethel, first vice-president and general manager. of the New York Telephone Company, has informed the Merchants' Association that after May 1 telephone rates to subscribers are to be reduced.

All direct line business subscribers will be charged at the new rate, regardless of the rate named in existing contracts. The new rate will be $60 for 600 messages instead of $75; $87 for 1,200 messages instead of $111; $111 for 1,800 messages instead of $141. The rates on 2,400 and more messages will be correspondingly reduced until the rate on 4,500 messages will be cut from $228 to $204 a year.

After June 1 this new schedule of rates from Manhattan and the Bronx will be adopted:

	From Manhattan.		From the Bronx.	
	Subscribers.	Pay Station.	Subscribers.	Pay Station.
Astoria	10	15	15	20
Barren Island	20	25	20	25
Bath Beach	15	20	20	25
The Bronx	10	15	—	—
Brooklyn	10	15	15	20
Coney Is'nd, Sheepshead Bay	15	20	20	25
Far Rockaway, Lawrence, Hammels	20	25	20	25
Flushing	15	20	15	20
Jamaica	15	20	15	20
Manhattan	—	—	10	15
New Dorp	15	20	20	25
Newtown	10	15	15	20
Queens	15	20	15	20
Richmond Hill	15	20	15	20
Tompkinsville, West New Brighton	15	20	20	25
Tottenville	20	25	20	25

A new schedule of rates for Brooklyn, places the toll for subscribers at $54 for a direct line, 600 calls, where it was formerly $66 for 700 calls, in the business districts, and $60 a year for a direct residence line instead of $75 as heretofore. In the Bath Beach and Coney Island districts there will be a reduction to $24 a year for party lines in private residences.

As a result of a meeting of a number of business men of Garretson, S. D., and farmers residing in that vicinity, the Palisade Telephone Company was organized. The following officers were elected: President, Adolf Koch; vice-president. A. O. Lerdahl; secretary, John Engebretson; treasurer, F. E. Locke. The line of the company will extend to a large number of farms in that part of the State, and will be connected with the local telephone systems of both Garretson and Sherman.

Capitalists and others whose business interests will be promoted, are endeavoring to form a company to construct a telephone line from Magnolia to Tylertown, Miss. The distance is 21 miles, and telephone interests would greatly facilitate the business interests of both places.

Moult Mount, manager of the Farmers' Telephone Company at Hopedale, Ill., will soon commence setting poles and stretching cables in the streets of Mackinaw, Ill.

Independents Preparing for Important Conference.

The coming convention of the Ohio Independent Telephone Association, to be held at the Hartman Hotel, Columbus, March 30, promises to be one of the best attended and most important conferences of Independent telephone men that has been held since the organization was formed.

Frank L. Beam, president of the association, has received assurances that each of the nine sub-district organizations will send its full quota of delegates, or one for each 1,000 telephones or less. He is led to believe that there will be at least 250 representatives of the Independent companies in attendance.

The officers of the association are: Frank L. Beam, president, Columbus; E. E. Knox, secretary, Portsmouth; Ralph Reamer, treasurer and assistant secretary, Columbus; executive committee: Ed. L. Barber, Toledo; Cyrus Huling, Columbus; J. B. Hoge, Cleveland, and Dwight E. Sapp, Mt. Vernon.

Bill to Tax Telephones.

The Francisco bill introduced in the New York Assembly proposes a tax of $5 per year to be paid by the telephone companies for each telephone operated, half the sum to go to the State and half to the town or city where such instruments are in operation.

News from Faribault, Minn., states that the Rice County Rural Telephone Company has filed articles of incorporation. Its capital stock is $100,000, divided into 10,000 shares, 5,000 preferred, and 5,000 common. The officers are: A. G. Chase, president. Isabella G. Chase, vice-president; W. T. Mollison, secretary and treasurer. The company will begin at once to install the plant.

The work of organizing a company for the construction of a telephone system between Toronto, Brandt and Astoria, S. D., is progressing. At a recent meeting a committee was appointed to prepare the articles of incorporation. Stock to the amount of several thousand dollars has been subscribed for.

Telephone facilities are being extended in the farming section surrounding Bennington, Vt. It is expected a line of several miles in length will shortly be constructed. The number of telephones in use in Bennington has now reached about 300.

D. E. & J. O. Kelley, merchants of Jeff, Ala., are completing a long-distance telephone system from Huntsville to that place. The new line will serve from 30 to 50 patrons.

The Fosterburg and Upper Alton Main Line Telephone & Telegraph Company, of Upper Alton, Ill., has changed its name to the Star Telephone & Telegraph Company.

The MacDougall, N. Y., Telephone Company has completed the erection of poles for its line from Geneva nearly to Kendaia.

The Boomerline Mutual Telephone Company, of Ottawa, O., has lately been incorporated by H. J. Hermiller and others.

Automatic 'Phones for Naval Station.

The contract has just been awarded for a private telephone system for the New Orleans, La., Naval Station, which will be of the automatic variety. It is expected that the system will be ready for operation in about three months.

The automatic exchange of the system will be connected with 25 telephones at the outset, but will provide for an ultimate capacity of 500 telephones. The local company will do the general wiring for the system, and the Automatic Telephone Company, of Chicago, will install the other equipment of the central exchange and the telephones.

The policy of the United States Government has of late appeared to be to install the automatic telephone service for its exchanges. The specifications for the installation at the New Orleans Naval Station called for automatic telephones manufactured under the Strowger patents by the Automatic Telephone Company, of Chicago, and consequently shut out all other telephone systems from the competition.

The Putnam, Conn., Business Men's Association had a large and enthusiastic meeting recently to consider the telephone situation. A committee of three, Col. G. D. Bates, G. E. Shaw and William H. Hammond, was appointed to look after pending legislation. Resolutions were passed calling attention to the condition of telephone service in that vicinity, and the desirability of legislation to remove restraint on competition.

Manager Domser, of the Black River Telephone Company, of Boonville, N. Y., lately sent out notices to the effect that after the first of April the price of telephones would be raised so that each 'phone would bring $12.50. This will have the effect of reducing a number of 'phones about that village.

To telephone from any one of its 54 mines direct to the company's headquarters at Pottsville, Pa., is the feat the Reading Company expects shortly to accomplish. That company is trying a new style of telephone in its inside mine workings, with this end in view, to expedite and safeguard the business.

The Farmers' Mutual Telephone Companies at Carroll, Henry, Ogle, Whiteside and Bureau Counties, Ill., representing 30,000 telephones, organized lately for protection against the old companies, especially the Bell.

A bill has been introduced in the Connecticut Legislature for the incorporation of the New York Independent Telephone Company.

Telephone Incorporations.

The Brainerd Telephone Exchange Company, Brainerd, Minn. Capital stock, $50,000. Incorporators: C. A. Waker, Warner Hemstead, F. H. Cruenbagen, H. P. Dunn, Mons Mahlam and H. D. Treglawny.

The Dunkard Valley Telephone Company, Garrison, Pa. Capital stock, $5,000.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Ackerman, Miss.—It is reported that T. F. McGee contemplates installing an electric light plant.

Ackley, Ia.—Improvements to the extent of $3,000 will be made to the heating and electric light plant here, operated by the Smith Brothers.

Amite, La.—The erection of another electric light and power plant here is in progress. The promoters of the new enterprise are H. C. Hall, of Amite; Hyman C. Reed, of New Orleans, and others. The new plant purposes to furnish light for Roseland and Independence.

Ashland, Va.—Frank J. Gould and others, have applied for a franchise to construct and operate an electric light and power plant.

Athens, Tenn.—The Athens electric light plant has been purchased by Long Bros.

Breese, Ill.—At the coming village election the question of establishing an electric light plant will be submitted to the voters.

Cherry Tree, Pa.—The Cherry Tree Electric Light, Heat & Power Company, with a capital of $5,000, has been incorporated by W. T. Mahaffey, R. E. Pitcairn, B. P. Kinports, C. V. Cameron and others.

Dayton, O.—The Montgomery County Electric Light Company, which has been incorporated by Robert R. Nevin, R. R. Knowles, Fred A. Funkhouser, Fred G. Withoft and William R. Craven, will conduct a business along domestic lines.

Dresden, Tenn.—This city contemplates issuing $10,000 of bonds for the construction of an electric light plant and waterworks.

Eureka, Ill.—W. J. Whetzel has been granted a franchise for an electric light plant in this city.

Fairview, Utah.—Incorporation papers for the Fairview Electric Light & Power Company have been placed on record by the Secretary of State. Its capital stock is $15,000, and officers: President, Peter Olsen; secretary and treasurer, Peter Sundwale.

Florence, Col.—The board of trustees of the town of Rockvale has granted to the Arkansas Valley Electric Company, of this city, a franchise to furnish electricity for light and motive power.

Forrest City, Ark.—W. H. Partridge has acquired a half interest in the electric light plant here.

Galion, O.—The Crawford Gas & Electric Company of this place, with a capital of $150,000, has been incorporated by S. N. Blake, R. P. Jenks, R. O. Morgan and others.

Harrisburg, Ark.—The town council has granted a franchise to the Harrisburg Light Company for an electric light plant. Lonnie Boone and Dr. J. M. Steele, of Greenfield, are interested.

Hillburn, N. Y.—An effort is being made and with a fair show of success to organize an electric light company to light Chester, Monroe, Central Valley and Highland Mills. The company will be affiliated with the Rockland Electric Company of this place, and will probably be called the Orange & Rockland Electric Company. The proposed capital is $30,000.

Luverne, Ala.—The Luverne Electric Light & Water Company, with a capital of $10,000, has been incorporated by J. R. Horn, J. M. Cody, R. G Reddach and others.

Lynchburg, Va.—This city is considering the establishment of an electric light plant to cost $40,000.

Lyons, Neb.—Bonds to the amount of $10,000 will be issued for the purpose of purchasing or installing an electric light plant.

Northwood, Ia.—The manager of the Northwood electric light plant contemplates the installation of an engine, two generators and a switchboard apparatus.

Oklahoma, Okla.—The Poteau Electric Light Company, capitalized at $10,000, has been incorporated with Malcomb E. Rosser, president; Edmond McKenna, W, A. Campbell and others.

Pana, Ill.—Eastern capitalists have purchased the electric light plant here.

Ponca, Neb.—On April 4 the citizens will vote on the proposition of bonding the city to the extent of $6,000 for the purpose of putting in a system of electric lights.

Port Lavaca, Tex.—Spittal Brothers, operating an electric light and ice plant, will install machinery for doubling the present capacity,

Syalcauga, Ala.—This city has engaged Arthur Pew, of Atlanta, Ga., to prepare plans for a waterworks and electric light plant, for which $20,000 in bonds have recently been voted.

Tekamah, Neb.—The citizens have voted to issue bonds to the amount of $10,000, for the purpose of installing an electric lighting plant, to be owned and operated by the city.

STREET RAILWAYS.

Delaware, O.—It is reported that the proposed electric line from Mansfield to this city has all the necessary financial means.

Des Moines, Ia.—W. S. Porter has had completed the preliminary surveys for a portion of the electric line he proposes to build in conjunction with the Polks between here and Nevada.

Elmore, O.—The officials of the Toledo, Port Clinton & Lakeside Electric Railway Company have been made a proposition to locate the power house and car barns of the company in this place

Findlay, O.—This city is endeavoring to secure the right of way for the North Baltimore, Bloomdale & Eastern Electric Railway.

Guadalajara, Mex.—An American syndicate, to be capitalized at $3,000,000, is said to be negotiating for the purchase of the street railways here, which are now operated by mules. The interests to be purchased include the concession for an electric street railway system, an electric lighting plant, and a large hydro-electric power plant at Juanacatlan and the transmission line to this city. Ramon Alcazar is one of the principal stockholders in La Electro Company of Guadalajara, which is part of the system involved in the purchase.

Harvard, Ill.—Another electric line will be erected to connect with the Chicago, Harvard & Lake Geneva Road in this city.

Independence, Kan.—The Union Traction Company has purchased a site here for the erection of a power house.

Long Island City, N. Y.—Each of the five sub-power stations building for the Pennsylvania Railroad Company in connection with the introduction of electricity as a motive power on the short lines of the Long Island Railroad, are to be connected with the main power house in this city, by means of three heavy copper wires.

Madison, Wis.—The Madison Traction Company has been purchased by F. Warren Montgomery, of New York. The property is valued at $500,000. F. Warren Montgomery, Jr., a son of the purchaser, will manage the system.

Missoula, Mont.—J. R. Wharton, of Butte, has applied for a franchise for the maintenance and operation of an electric street car system in this city.

Omaha, Neb.—It is stated that an electric line will be built between this city and Fort Crook.

Vermilion, S. D.—Farmers in the northern and eastern part of Clay County are very enthusiastic over the proposed electric railroad that is to be operated between Sioux City and Volin, S. D.

Zanesville, O.—The Muskingum, Coshocton & Tuscarawas Electric Railway Company, with an initial capital stock of $10,000, was lately granted a charter by the department of State. The road will be confined to Muskingum, Coshocton and Tuscarawas Counties, with this city and New Philadelphia as the termini. The incorporators are J. J. Adams, W. T. Koontz, F. S. Mooney, J. R. Alexander and H. I. Buell.

POWER PLANTS.

Chicopee, Mass.—Plans have been prepared for an electric power plant for the Dwight Manufacturing Company.

Knoxville, Tenn.—It is reported that the Knoxville Power Company is completing arrangements for the erection of its proposed power plant.

Tahlequah, I. T.—A plan has been developed to dam the Illinois River and establish a large power plant for this place. The Illinois is a mountain stream within two miles of town, and there is sufficient fall in it to get a good head for water power without a very expensive dam.

BIDS WANTED.

Dallas, N. C.—The town commissioners want bids on the installation of an electric light plant, 25 to 40 hp. J. C. Puett, mayor.

De Pere, Wis.—Sealed bids will be received by the board of trustees for the construction of the proposed electric lighting plant at the County Insane Asylum.

Dillard, N. C.—C. A. Mitchell, of this place, wants a good second-hand, 12 or 15 hp. boiler on skids.

Louisa, Ky.—A. Snyder, president of the Louisa Canning Factory, wants prices on a 40 hp. boiler.

Morganton, N. C.—The State Hospital located here wants three 150 hp. boilers.

Tuskegee, Ala.—This town will want complete equipment for an electric light plant of 800 to 1,000 16-cp. lights, including boiler and engine of about 60 hp., dynamo, wire, etc. Address W. H. Crawford.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15¼@15⅜c.; casting, 14⅞@15c.

The General Electric Company's quarterly dividend of 2 per cent. will be payable April 15.

It is said that the Philadelphia Electric surplus for 1904 will be $700,000 beyond interest charges.

The general offices of the Allis-Chalmers Company are to be removed from Chicago to Milwaukee May 1.

The Capital Traction Company of Washington, D. C., has increased its annual dividend rate from 5 to 6 per cent.

The $50,000,000 Chicago Subway Company will make its first railroad terminal freight connection within the next 30 days.

It is stated from headquarters that the gross earnings of the Bell Telephone Companies last year were something more than $80,000,000.

The Electric Storage Battery Company declared the regular quarterly dividends of 1¼ per cent. each on its preferred and common stocks, payable April 1.

The Westinghouse Electric & Manufacturing Company has declared the regular quarterly dividends of 2½ per cent. each on its preferred, assenting and non-assenting stocks, payable April 10.

An application has been made to the Rhode Island General Assembly for the incorporation of a company, to be capitalized at $1,000,000, to build an electric railroad from Narragansett Pier to Point Judith.

Indications are that for the second quarter of the fiscal year of the Massachusetts Electric Companies, ending March 31, gross earnings will show an increase of over $100,000 and that the earnings for the quarter will show a larger gain.

It is reported that the $10,000,000 bonds of the Philadelphia Rapid Transit Company will be underwritten at 98½ and interest. The bonds will run for 50 years and bear interest at the rate of 4 per cent. The underlying syndicate extends to March 1, 1906.

Kidder, Peabody & Co. have been delivering American Telephone & Telegraph Company's 4 per cent. gold bonds for some days, especially to New York. To date, the American Tel. & Tel. Company has received approximately $16,000,000 from the sale of the bonds.

President McMillin, of the American Light & Traction Company, in his annual report to the stockholders says that the earnings of the company increased 6.54 per cent. over the preceding year and the expenses decreased 37.81 per cent., giving a net gain in profit equal to 7.82 per cent.

The New York City Interborough Railway Company has received the approval of the New York State Board of Railroad Commissioners on its application to increase its capital stock from $400,000 to $5,000,000 and to issue a mortgage for $5,000,000. The company was also granted authority to use the overhead electric trolley. The company is to operate lines throughout the Borough of the Bronx.

The Metropolitan Street Railway Company of New York will technically not pay a dividend for the current quarter, but on April 15 it will distribute to shareholders of record on March 24 their proportion of the rent received for their property from the New York City Railway Company, which will be at the rate of 1¾ per cent. on the stock. In this the company and stockholders save the tax on dividend.

ELEOTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Mar. 25
New York City.	
Broadway and Seventh Avenue	241
Manhattan Elevated Railway	168¼
Metropolitan Street Railway	122½
Metropolitan Securities	87⅞
Ninth Avenue	197
Third Avenue	132¾
Twenty-third Street	410
Other Cities.	
Brooklyn City Railway	239
Brooklyn Rapid Transit	67⅝
Interborough Rapid Transit	209¾
New Orleans Railway	4¼
Public Service Corporation (New Jersey)	141
Philadelphia.	
Consolidated Traction of New Jersey	83
Philadelphia Traction	100⅛
Union Traction	59
Boston.	
Boston Elevated	156
Massachusetts Electric Companies, com	20¼
do. do. do. pref.	67
West End Street, com	97
do. do. do. pref.	116¼
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	11⅛
do. do. pref.	45
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	16⅛
do. pref.	62
Electric Boat, com	41
do. do. pref.	84¼
Electric Lead Reduction	¼
Electric Vehicle, com	14¼
do. do. pref.	24
Westinghouse, com	181
do. pref.	192
General Electric	187
Boston.	
Edison Electric Illuminating	254
General Electric	186⅞
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	46
do. do. pref.	114
Philadelphia.	
Electric Company of America	12
Electric Storage Battery, com	83¾
do. do. do. pref.	83¾
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	144¼
Western Telephone Company	20¼
New England Telephone Company	138
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210¼
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	172¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93
Chicago Telephone Company	142
MISCELLANEOUS STOCKS.	
Otis Elevator Company	53
Consolidated Car Heating	64
Standard Underground Cable	200

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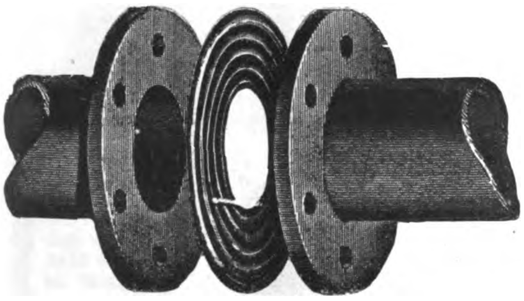

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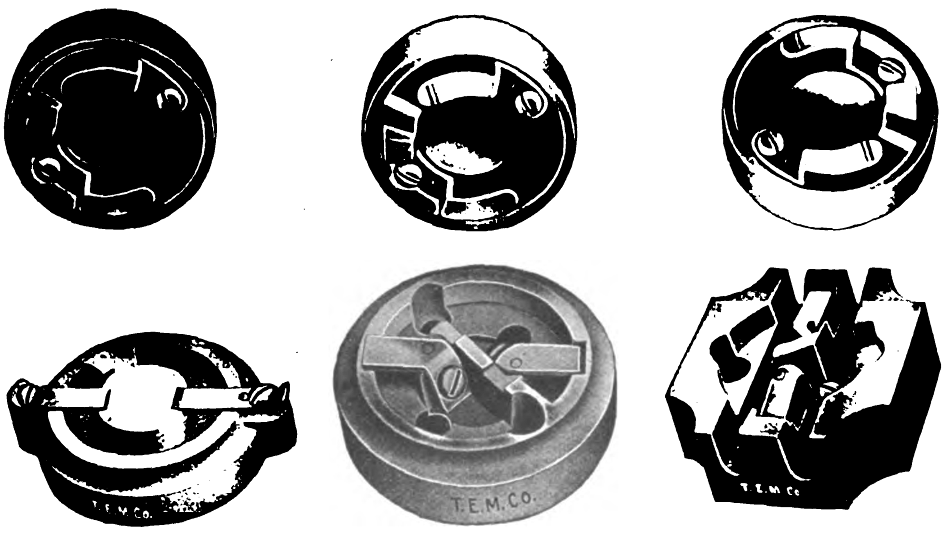

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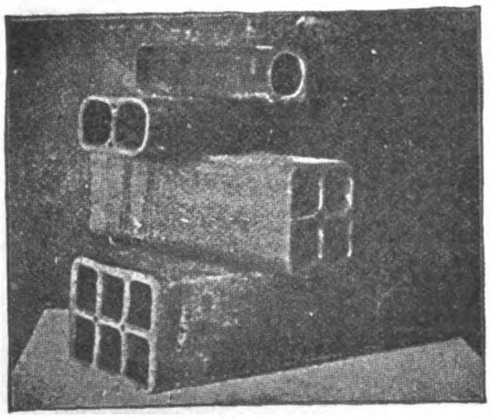

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ELECTRICITY.

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EDITORIAL NOTES.

Proposed Subways. Plans for rapid transit in Greater New York would seem to be like a wedding ring, "without beginning and without end." And yet the gigantic undertakings in this line which are now being projected are not surprising when we bear in mind that the population in this vicinity is increasing at the rate approximately of 15,000 a month. In other words, facilities or means have to be provided for carrying in a year 180,000 more persons than now, or, in five years, 900,000 more people.

It is no wonder, then, that there is talk of spending $300,000,000 in the no very distant future for new subways and tunnels. The plans which are expected to meet the demands of New York City for many years to come have been submitted to the Rapid Transit Commission and will undoubtedly be approved by that body this week. The submitted plans provide for nineteen routes on the east and west side, crosstown and in the Bronx.

To just what extent the city may be called upon to finance the extension of the rapid transit system cannot be told until it is known how much private capital may be put in the work. Upon this point the report of the Plans and Contract Committee says:

"The estimated cost of the routes now proposed, and for which the committee believes there are probable bidders, will very materially exceed the means now available to the city for construction; but there is reason to believe bids may be anticipated which will only call for an amount of municipal investment well within the present ability of the city. As the time is now favorable from the city's standpoint for the making of contracts for several lines of railroad which seems to meet with the conditions laid down, the committee recommends that such routes, although distinct, should nevertheless be approved at the present time and together."

It is the opinion of the commission that contracts much more favorable to the city than those made when the first subway was built will now be obtained.

* * *

Commutation Observations by Oscillograph. Owing doubtless to the experimental difficulties there has in the past been a lack of data concerning the exact behavior of the current in an armature coil during the period that its ends are under a brush. The pre-determination of the commutation qualities of a given design has, therefore, been a matter of considerable uncertainty. The position is, however, now altered by the availability of the high frequency type of oscillograph, which enables us to obtain the commutation curve and flux distribution with little more trouble than the indicating of a steam engine. The rating of perhaps 50 per cent. of the continuous current machines manufactured is determined by commutation rather than by heating; also, the size and range of variable speed motors, the range of voltage on generators, and the whole design of turbo-driven machines are settled chiefly by whether the commutation is sparkless or not. For these reasons it is somewhat surprising that commutation curves have not been more often obtained by designers.

Mr. J. K. Catterson-Smith last year carried out some investigations with a view to recording by means of the oscillograph the actual manner in which the current is reversed during commutation, and he presented the results, a digest of which will be found elsewhere in this issue, at a recent meeting of the Birmingham section of the Institution of Electrical Engineers.

* * *

The Value of Method in Electrical Engineering

It is almost impossible to realize the extent of the rapid transformation that has occurred in so short a time in the science and application of electricity. This transformation is not to be regarded as the result of extraordinary conditions, but rather as an inward process taking place under the influence of persistent and vigorous experimenting. It can be construed in other terms as method, and as such belongs to a new and important category. It may be translated into the new language of commercial progress under the title of scientific manufacturing.

Science has been defined as organized knowledge. By this is meant the grouping of correlated facts under headings which represent a perfectly definite relationship to each other and to the central and crowning proposition of the total aggregation.

In other words, the method of science has become the method of manufacturers. Competition calls for the best possible product at a cost to the manufacturer that gives him leeway in the industrial struggle with his neighbor. His neighbor is engaged in the same effort as himself, and therefore both are required to operate with an amount of money, skill and brains that will lead to this possible though limited supremacy in this field Method, then, is in many respects the only distinguishing feature between one and the other. What this method may be, whether it lies in the line of scientific ability in the creation of the type of machine or other device, or in the development to its highest economic climax of the shop practice employed, is the balancing up of one man's wit against another's. Superiority may lead to swift advancement, and this to such broad and comprehensive applications of crystallized scientific ideas that enormous projects may be handled, their consummation leading to changes of general public usefulness in the ordinary walks of life. This has been the case, as far as the value of method is concerned, in the first feeble efforts to build an electric motor. Conceptions of how this could best be done, reviewed in the light of our present knowledge, can only be classed as chaotic. The first motor ran, but as a device which embodied only one idea, the principle of rotation by electricity. In all other respects it was as archaic and as imperfect as the early inscriptions to the philologist on the tombs of Egyptian kings or the rude carvings of primitive men to the magnificent ideals of the sculptor Rodin.

It was necessary at this period in the history of the motor to employ method in discovering those scientific principles so necessary to its ultimate perfection. And then, when it had reached a stage of development that entitled it to construction on larger lines, method was again necessary to find the best way to build and assemble the parts that constitute the complete machine. This is the dominant influence in electrical works to-day, and the triumphs it has achieved are from this standpoint more the triumph of method than those of discovery. The savant earns his fame by that peculiar organization of mind which leads him to suspect the operation of new laws. Here, he uses a function like Newton, Davy, Kepler, Faraday, Helmholtz or Kirchoff, through which a new way of thinking is promulgated. From one standpoint, the intellectual influence is the most beneficial of all, but from the more practical or material standpoint, the new way of working is the most beneficial of all. Method has spelled the word progress; it is the index finger pointing the way along the rocky road of experimentation and manufacturing.

The electrical engineer exists to-day because electrical engineering exists. And it is but a step to reason that electrical engineering is the direct outcome of method in not only the large and elaborately equipped laboratories of our colleges and universities, but in the great workshops that dot the face of this continent, busy with the practical problems of electric lighting, electric railroading and the electric transmission of power.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Lord Kelvin is dangerously ill in London, the result of an operation for internal trouble which he underwent last week.

M. Emile Guarini, a frequent contributor to the columns of ELECTRICITY, has been engaged by the Peruvian Government as professor at the School of Engineering of Lima and at the new School of Arts et Metiers about to be opened.

The conventions of the Iowa Electrical Association and the Association of Electric Railways in Dubuque on April 19 and 20 promise to be the biggest held in the history of the organizations.

The national conference on standard electrical rules—composed of delegates representing manufacturers or operators of electric plants and underwriters—will hold a meeting at 55 Kilby street, Boston, Friday, April 21.

One of the principal features of Commodore Peary's plans for his coming trip in search of the North Pole, will be the establishment of wireless telegraph stations along his course to the north.

It is believed that the international commission suggested by the St. Louis Congress in the matter of international uniformity in electrical units will meet in Geneva or The Hague.

The New York Motor Club has decided to set aside June 7 each year to treat all the orphan children of the city to an automobile ride. It is thought more than 1,000 machines will be in line.

Electric motors will be used by the Swedish Government as an experiment on the State railways. If they are successful, the entire railway system of Sweden will be equipped with electric motors, and steam locomotives will be done away with. The Swedish Government proposes to use the powerful water falls of that country to create the electricity, as fuel is expensive and has to be brought from Cardiff, Wales.

The German Government has indefinitely postponed the international wireless electrical conference which was to be held in Berlin this month.

According to the Paris correspondent of the London "Telegraph," radium has been found near the village of Grury, in the French district of Autun, and the Department of Saone-et-Loire, the chief town of which is Macon. The discovery is only very recent, and mining operations are not yet advanced, but it is said that considerable quantities of pitchblende have already been taken out. The seam of mineral ore opened up appears to be abundant. The whole countryside is excited by the find and dreams of future wealth. The owners of the mine just excavated are confident that they have struck a plentiful layer of radiferous ore, so neighbors follow the operations with covetous wonder, and think of digging up their own fields in search of the precious pitchblende.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

Electric Railways.

Long Distance Electric Roads.—The adaptability of the overhead trolley system to this purpose is evident from even a superficial examination of practical conditions. The greater the distance between the power house and the end of the road the greater the cost of the system. This is true particularly with the old established method of using a direct current of 500 volts and an elaborate feeding system to reinforce the pressure and current. The capital invested per mile of track, including the cost of the power house, is the factor which in many respects limits the length of a line. Electric roads can be built to reach as far out into and across the country as steam roads, but the expense attached to such an experiment under present conditions of practice is too high to prove interesting to capitalists. Thus it becomes evident that applied science or engineering projects rapidly present a new phase of interest. They can only become established as definite propositions if their cheapness as well as practicability is expressed by reasonable limitations. Not only are long-distance roads desirable operated by electricity but they must also present the feature of high speed as well. In this last respect the adaptability of the motor is unquestioned, and recent experiments have clearly proven a superiority that fully bears out all such anticipations.

Within city limits the system in vogue is based upon the idea of sub-stations. The power originally generated is converted into a high pressure alternating current which is distributed to a series of sub-stations or transforming houses. From these parts feeding lines radiate to different points of the electric road, sustaining the pressure and leading, if necessary, to the further extension of the road. The longer the line the more numerous of necessity becomes these subsidiary stations and in consequence the expense of this reinforcement rapidly reaches very high figures. Yet this idea is the one which has exerted an extraordinary influence upon the development of electric roads for street railway purposes within large cities. It is the method employed by the Interurban Company of Greater New York and has proved of immense value from an economical standpoint as compared with the original system, devoid of such ramifications as sub-stations and necessarily limited in its zone of activity on account of the costliness of the equipment.

Sub-stations have paved the way for a healthier development of the electric street railway system; the flexibility of the alternating three-phase system aided by the application of rotary converters has placed electric railroading upon a broad and efficient basis. Great extensions of track, in fact, long distance roads, are not practical even with these improvements, because both theory and practice clearly indicate the necessity for a simpler system, and, what might be regarded as a corollary to this presumption, a much higher pressure.

Requirements of a Long-Distance Road.—These requirements can be tabulated as a series of conditions imposed by the financial and scientific aspects of the problem; they are

1—High pressure for transmission.
2—High insulation for the trolley line.
3—Low cost per mile of road.
4—Simple devices to control the car.
5—Construction, of a most durable character.

Though but part of the long list that a close inspection of the proposition would indicate these items are most important in the light of modern progress. To meet the first requirement in a practical and economical manner, experiments have been directed along the lines laid down by alternating current practice. It can be stated at present almost as a certainty that any great advancement made in electric railroad work will be by means of the direct application of the single-phase alternating current. A trolley line supplied with this form of energy at a high pressure can readily transmit its power to a car equipped with simple series motors, the iron of said motors laminated and the control of them obtained by very simple means.

Alternating current practice represents essentially the economical application of electricity over long distances. The great power transmission plants are the most prominent illustrations of this character. The combination of these ideas with those required for electric roads seems to be the drift of present experimentation. An alternating current single-phase electric road is in operation at present with a pressure in the overhead trolley wire and tracks of 16,000 volts. The greatest care was taken in the construction of this line to make every part of the system solid, durable and well insulated. In this case, instead of a series of expensive sub-stations with rotary converters and other accessories the power is sent direct with occasional reinforcement where necessary. The cost per mile of road is thereby greatly reduced and, in consequence, the earnings express a better financial relation to the cost of installation or total investment than could be obtained under equal conditions by the use of a 500-volt direct current system.

Third-Rail and Overhead Trolley Compared.—Comparison is frequently a better means of realizing the truth than mere description. The only difference between a third-rail and an overhead trolley system might be best expressed by the statement that one is an overhead trolley and the other is a ground trolley. In fact, no actual difference exists except in this respect, either in the character of the machinery employed or the transmission and distribution of the power. The advantage of solidly supporting a live conductor, namely, the third-rail, where it can not fall, is counterbalanced by the difficulty of insulating it and its direct danger to the public. The third-rail is best suited to elevated structures, to stretches of protected track, to tunnels, etc. Tabulating these applications, the case is presented as follows:

I.—ADVANTAGES OF THE THIRD-RAIL.
Solidity of construction.
Cheapness of construction.
Better conductivity.
Greater durability.
Accessibility.

II.—DISADVANTAGES OF THE THIRD RAIL.
Difficulty of getting good insulation.
Danger to life.
Exposed to snow and rain.
Requires frequent bonding.

III.—APPLICATIONS OF THE THIRD-RAIL.
Elevated structures.
Protected stretches of track.
Tunnels.

In contradistinction to these factors are the advantages of the overhead trolley system, with the exception of the necessity for bonding and the possible question of the safety of the overhead trolley as far as life and limb are concerned. The question of insulation is obviously an open one with greater advantages on the side of the overhead conductor. Climatic conditions, such as the effect of long continued rains, snows, and sleet storms, are obviously bad in both cases. At the best, the overhead system is comparatively delicate, and unquestionably doubtful where long stretches of road are to be equipped. Constant inspection would be one of the only remedies for this, backed up of course by the use of the strongest and most reliable construction and material.

The Sprague Multiple Unit System.—

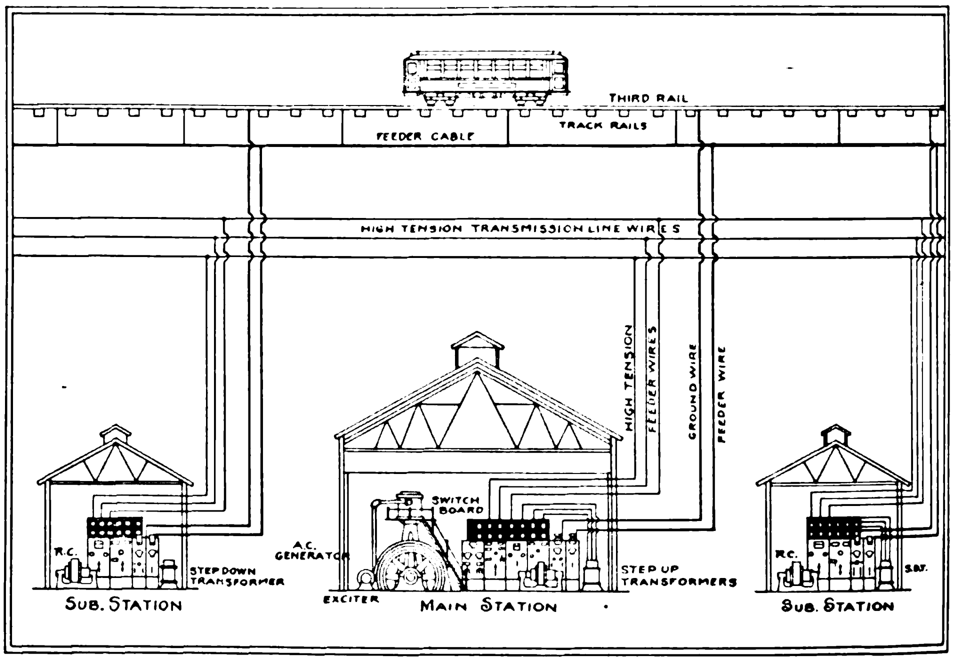
Whether trolley or third rail is employed, the system of coupling and uncoupling carried out in a steam road, must be duplicated in any electric system which hopes to successfully compete in the open field. The Sprague multiple unit system presents all these features, that is, the possibility of connecting an electric car to another, or a third or fourth, and having but one motorman exercising control over the entire train. This remarkable feature of electric control, the ability to couple up electric cars, each equipped with their own motor, and all under the management and subject to the will of one man, has greatly furthered the development of electric train service. Among the fathers of electric railroading, such as Daft, Van Depoele and Reckenzaun, no name shines so brightly as that of Frank J. Sprague. Both the elevated and underground systems employed in Manhattan Borough, New York, are multiple unit.

High Speed Electric Systems.—Systems of high speed electric service have appeared from time to time on paper, but few have ever reached a degree of crystallization entitling them to serious attention. The question of lubrication is always a serious one at high speeds; and the relationship existing between the weight of the car and the width and weight of the rails, is of supreme importance. The character of the road-bed must also be considered, and in conjunction with these things, the grades and declivities. Reciprocating engines, such as the locomotive, impair the road to a considerable extent in the course of a year. The absence of this pounding and the placing of the motors directly over the driving wheels in each truck is a most important point in favor of the electrification of steam roads.

In earlier days the motor was not sufficiently well constructed to stand the wear and tear of much travel. It was geared to the driving wheels of each car, and in consequence created a great waste of energy. The latest types of electric locomotives constructed for the use of the New York Central Railroad have their four driving motors so constructed that the extremities of the armature shaft are supplied with wheels, the power being thus directly applied. The motors are of 550 hp. apiece, four giving 2,200 hp. when in full operation. A speed of 70 miles an hour is readily acquired in this case, and even a speed of 90 miles under propitious conditions.

The speeds attainable in practice have reached their highest figures in Germany where a 100 miles stretch of road was repeatedly covered by an electric car at a rate exceeding 100 miles an hour. The peculiar construction of the series wound motor is such that its speed and torque can be readily increased by greater pressure and current. On the other hand, if gearing is used so as to advantageously employ any excess of torque the motor may develop to increase the rate of acceleration of the car, then high rates of speed are readily obtainable. The experimental phase of the problem has been successfully reached and passed, and the next stage to undertake is that of reducing the proposition to a more practical form. All of the mechanical objections are present which govern and perhaps limit high speed in a steam locomotive. These are air resistance, slippage, lubrication, etc., but whereas high speed cools a steam locomotive, and therefore diminishes its efficiency, the very opposite will result with a motor. The ability to increase the grip of the car upon the rails in electric cars by placing the motor, the main weight, where its power is most readily utilized, is a great feature in its favor in high speed railroading. At high speeds; such as 100 miles an hour or over, the air pressure is comparatively enormous and seriously impedes the motion of the car or train.

Large amounts of power must be on tap to insure the success of such a system, and of necessity the motors must be unusually powerful. Where a giant steam locomotive develops 1,000 hp. or a little over, an electric locomotive of equal size and weight would produce 2,000, and under a severe test 3,000 hp. This power translated into speed represents the extent, at present seemingly unlimited, which may be reached in the future. Provided the weight on the rails is sufficiently great, and the driving power is present, it is entirely within the province of reason and common sense to expect within the next decade speeds on specially installed electric roads reaching into the figures of 100, 150 and even 200 miles an hour.



The General Plan of a Modern Street Railway System.

General Plan of an Electric Road.—The principle on which an electric road is laid out operated by direct current, is based upon the fundamental ideas of

Generation of power.
Transmission of power.
Distribution of power.
Protection of the system.

The generation of the power involves a brief description of the station and its constituents. These are included under the head of those items familiar to the workers in power houses and bearing the title of

Steam plant.
Generating plant.
Feeding system.
Switchboard.
Lightning arresters.

The steam plant consists of boilers and engines with their accessories, and the generating plant of the dynamos alone. The feeding system includes the transmission, if it consists of rotary converters, sub-stations, transformers and feeders. The switchboard carries the measuring instruments, the switches, the feeders from the station, circuit breakers, and the lightning arresters. This in itself may be considered as consisting of apparatus connected to the generating section, metering section and feeding section. Thus the generation of the power, the transmission of the power, its distribution and the protection of the power house, lines and cars is accomplished by the application of principles of an elementary character, crystallized by necessity into that class of devices best suited to these new requirements.

Circuit Breakers.—The old-time fuse with its dangerous flash has been dispensed with, and in its place, the circuit breaker, or electro magnetic switch is employed. The circuit breaker may be inserted in either one pole or both according to its construction for the protection of circuits. A sudden rush of current energizes the magnet sufficiently to cause its pull to release a catch which releases the switch and it flies open propelled by powerful springs. Cars on a street railway line are all supplied with this form of protection against a short circuit. The feeders leading to the tracks and trolley, third rail or tee rails within the open conduit are similarly protected, and all of the power-bearing lines including the mains themselves.

Lightning Arresters.—The protection is not limited to these breakers, but is added to in the form of lightning arresters, to which any exposed system of lighting or power is particularly exposed. The idea of these devices is not only to direct lightning to the ground, but to relieve the line of any rise of potential, which would tend to threaten the insulation of the plant. These rises of potential are insidious in their nature, occurring without any manifestation of their presence, and absolutely requiring a vent or outlet in the form of an arrester, if the plant is to be saved from injury. The resulting dangers in this case arise from the possible grounds and short circuits which ruptured insulation would cause.

A NEW OPERATING DEVICE FOR AUTOMATIC REGULATORS.*

The usual method of automatically regulating the voltage of a circuit involves the rise of a delicate relay or contact voltmeter device for the purpose of setting the regulating apparatus (cell switch or resistance switch) in operation. A rise or fall in voltage from the normal deflects the voltmeter and closes a local circuit which starts the regulator in the correct direction for producing the required change in voltage. As soon as the normal voltage is reached again the contact is broken at the voltmeter and the regulator comes to rest in its new position.

For direct current circuits the voltmeter often takes the form of a solenoid connected across the voltage to be regulated, and acting on a tubular iron plunger suspended inside it by means of a spring. This plunger carries a contact arm free to make contact with one or the other of two fixed terminals, according to the position of the plunger in the solenoid. The position of the plunger is determined by the opposing actions of the magnetic pull due to the solenoid and the pull of the spring, and a definite position corresponds to every voltage across the solenoid. Any change in voltage causes one or the other of the forces to preponderate to an extent depending on the amount of the voltage change, and the plunger takes up a new balanced position. If a contact is to be closed by this movement, it is clear that the plunger must be arrested before the new balanced position is reached if there is to be any force available for making the contact. On this account only a fraction of the net increase in pull can be actually employed. Further, the total net increase in pull will itself be very small because the apparatus must be sensitive enough to act under voltage changes of the order of 1 per cent., so that only something like ½ per cent. of the total ampere turns in the solenoid can be employed for actually making the contact. The smallness of the actuating forces makes all such apparatus very delicate and the distances moved through are also very small, so that only very small currents can be dealt with at ordinary voltages. Similar objections apply to contact devices of the Deprez type, in which a coil carrying the current moves in the field of a permanent magnet, and also to those of the Ferraris type, used for alternating currents, in which a metal disk moves under the action of a revolving field against the action of a controlling spring. These objections have led to numerous attempts to solve the problem in other ways, but without much practical success hitherto.

The "Elektrotechnische Zeitschrift" describes a new device, recently put on the market in Berlin, which would seem to overcome most of the difficulties. In this instrument two ordinary horseshoe electromagnets are employed, one to cause increase in voltage when required, and the other to cause decrease in voltage. A single electromagnet would be useless alone, because of the wide difference which would exist between the exciting voltage, which just caused the armature to be attracted up, and that which just allowed the counteracting spring to draw it off again. On the other hand, an electromagnet can be relied on to make satisfactory contact when once the magnet actuating voltage is reached, for as soon as the magnetic pull overbalances the pull of the spring the armature moves towards the magnet, and so reduces the air-gap and increases the flux, which still further increases the pull. The armature is therefore drawn on with a rapidly increasing force in spite of no further increase in voltage occurring, until it comes in actual contact with the magnet, or, at any rate, until the required electrical contacts are securely made. By employing two independent magnets this desirable result can be insured for both decrease and increase of voltage from the normal, the magnets being set so that at normal voltage the armature of one of them is just on the point of being attracted up by the magnetic pull, and that of the other is just on the point of being pulled off by its spring.

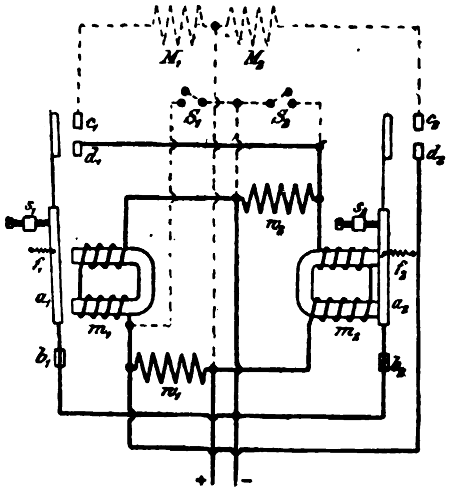


Fig. 1.

The actual connections employed with this apparatus are shown diagrammatically in Fig. 1; m_1 and m_2 are the two magnets connected to the supply (+ −) through the resistances, w_1 and w_2. m_1 makes contact when the voltage is above the normal, and m_2 when it is below the normal. The diagram shows the conditions existing at normal voltage. The adjustment of the screw s_1 and the spring f_1 determine the upper limit of voltage, and the adjustment of the screw s_2 and the spring f_2 determine its lower limit. Suppose that an excess voltage occurs. The first effect will be the drawing up of the armature a_1, connecting b_1, c_1 and d_1. This sends a current through the voltage adjustment apparatus, M_1, by means of which the circuit voltage is lowered, and at the same time the auxiliary switch, S_1, is closed. This short-circuits the magnet winding of m_1, and so allows the armature a_1 to fly back under the action of the spring f_1 into its normal position. This return opens the contacts c_1 d_1 and brings the voltage adjustment gear, M_1, back to its normal position and opens the switch S_1 again. In this way the original state is reached once more, with the exception that, in the meantime, the voltage has been lowered by the required amount, and so the armature a_1 will not be drawn up again. If, on the other hand, the voltage falls below the normal, the armature a_2 will be allowed to fall and contact will result between b_2, c_2 and d_2, and the regulating apparatus, M_2, will be energized. This raises the circuit voltage, and at the same time closes switch S_2, which short-circuits the resistance w_2 in series with magnet winding m_2, and so strengthens this magnet sufficiently to insure the armature a_2 being drawn up once more. This opens the circuit of M_2 and allows the voltage adjustment gear to return to its normal position and also opens the switch S_2, thus reaching the original condition again, with the exception that the current round m_2 is somewhat increased by the rise in voltage effected. The contacts d_1 d_2 form a safety device for insuring that both armatures shall never operate at the same time—for instance, owing to sudden voltage variations or to mechanical vibration of the instrument. When a_1 is drawn up, the operation of a_2 is prevented by the short-circuiting of the resistance w_2 through d_1 b_1. When a_2 is down, the operation of a_1 is prevented by the short-circuiting of the magnet winding M_1 through d_2 b_2.

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*From the "Electrical Engineer," London.

The sensitiveness of the apparatus depends entirely on the accuracy of its construction. With the ordinary care obtainable in a manufacturing workshop, and the employment of flat steel springs for the armature supports, fine-thread adjustment screws at s_1 s_2, and long springs at f_1 f_2 (insuring their being stretched by only a small fraction of their length), voltage regulation within a fraction of 1 per cent. can be depended upon. Such accuracy is seldom required in practice—e. g., with cell switches the minimum steps which can be employed are of 1.9 volts each—but the fact that the instrument is capable of such fine adjustment insures accurate results, whatever the limits may be for which it is set. The contacts consist of copper and carbon, and are so solid in construction, and the pressure with which contact is made is so great, that the instrument can deal with currents of several amperes at 220 volts, and so can be used without additional relays for the operation of quite large motors. The large forces employed prevent the ordinary vibrations met with in engine rooms affecting the working at all, as they are liable to do in the case of the ordinary contact voltmeter devices, so that the apparatus can safely be mounted direct on the switchboard.

* * *

PROVIDING FOR INCREASE OF POWER IN ISOLATED STATIONS.

ARTICLE III.

BY W. H. WAKEMAN.

Fig. 3 illustrates another plan for driving dynamos that is in use in many stations. A medium speed engine with a stroke equal to about twice the diameter of cylinder is belted to a line shaft that extends the entire length of station. It carries pulleys which drive dynamos wherever wanted.

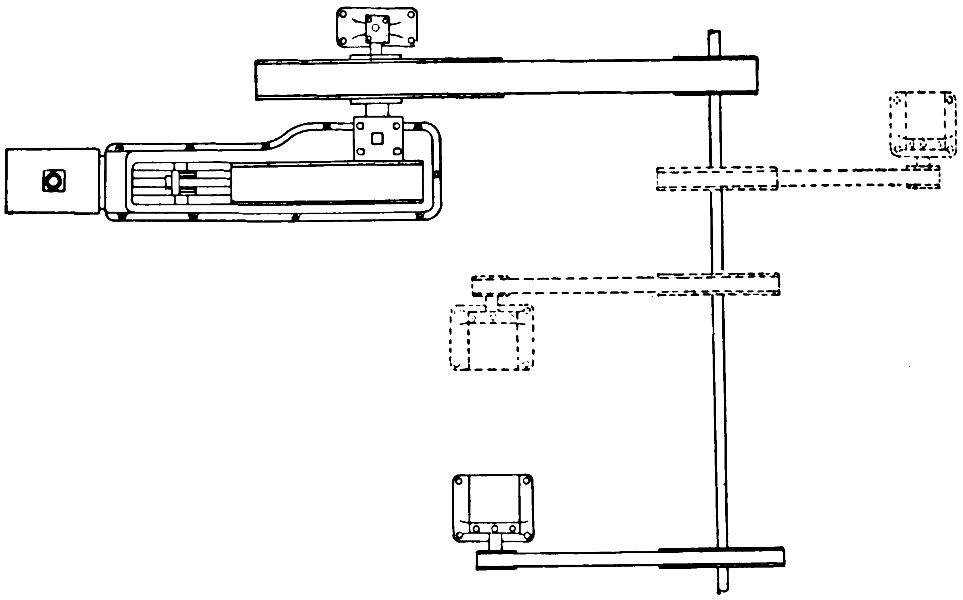

Fig. 3.

It will be well in this connection to state what is meant by a medium speed engine. Suppose that the diameter of cylinder is 20 inches and the stroke 42 inches, making the latter a little more than double the former. Assuming that this engine revolves 90 times per minute, the piston speed is 630 feet.

It is proper to rate 90 revolutions per minute as a medium speed, as 110 or more would be high and 70 or less would be low speed, but a piston speed of 630 feet per minute is high. If we compare it with a 12 by 12 inch engine at 300 revolutions per minute, giving a piston speed of 600 feet, it is at once apparent that it is high because every steam engineer rates 300 revolutions as high, yet the piston speed is less than for the lower rotative speed. From this reasoning it is plain that when an engineer speaks of a high or low speed engine he generally means the speed of crank shaft, and not of piston.

In Fig. 3 the full lines represent one large dynamo that is sufficient for the amount of current required when the station is new while the dotted lines show others that were added as the demands for electricity increased, thus calling for much more power than was wanted the first year.

A very good plan for providing the larger amount of power wanted may be described as follows: The boiler pressure is 75 pounds for the smaller load, but is increased to 100 or 110 as more power is wanted. At first the speed of engine is 70 revolutions per minute, with a main pulley on the line shaft the right diameter to give the required speed. It is increased from 70 to 90 revolutions by changing the governor pulley. In Fig. 4 the pulley on crank shaft 2 is 16 inches in diameter and we wish to have it revolve 70 times per minute. The governor pulley 3 will revolve 120 times per minute regardless of other conditions as that is the speed it was designed for, and it is stamped on the governor. Then 16 × 70 ÷ 120 = 9.3, which is the required diameter of governor pulley. As a general rule when it is desired to increase the speed of an engine the easier way is to change the diameter of governor pulley. I wish to emphasize the fact that the speed of governor remains constant, regardless of all other proper changes, as it is the standard. Engineers frequently remark that when a change is to be made the governor will run either slower or faster, but that is a mistake, and whenever heard it always denotes that the speaker is not well informed on the subject.

When more power is wanted in this case the speed is raised to 90 without changing the crank shaft pulley 2. Then 16 × 90 ÷ 120 = 12 inches, which is the required diameter of new governor pulley.

On some engines, as for illustration the Corliss, Greene, etc., it is possible to make slight changes in speed by altering the cut-off mechanism, but that is all wrong and should never be tolerated, for by so doing the average engineer will introduce dangerous conditions without knowing it, until a so-called "accident" results in which one or more lives are lost and much property destroyed. If the change is not worth making in a safe and proper way do not make it at all.

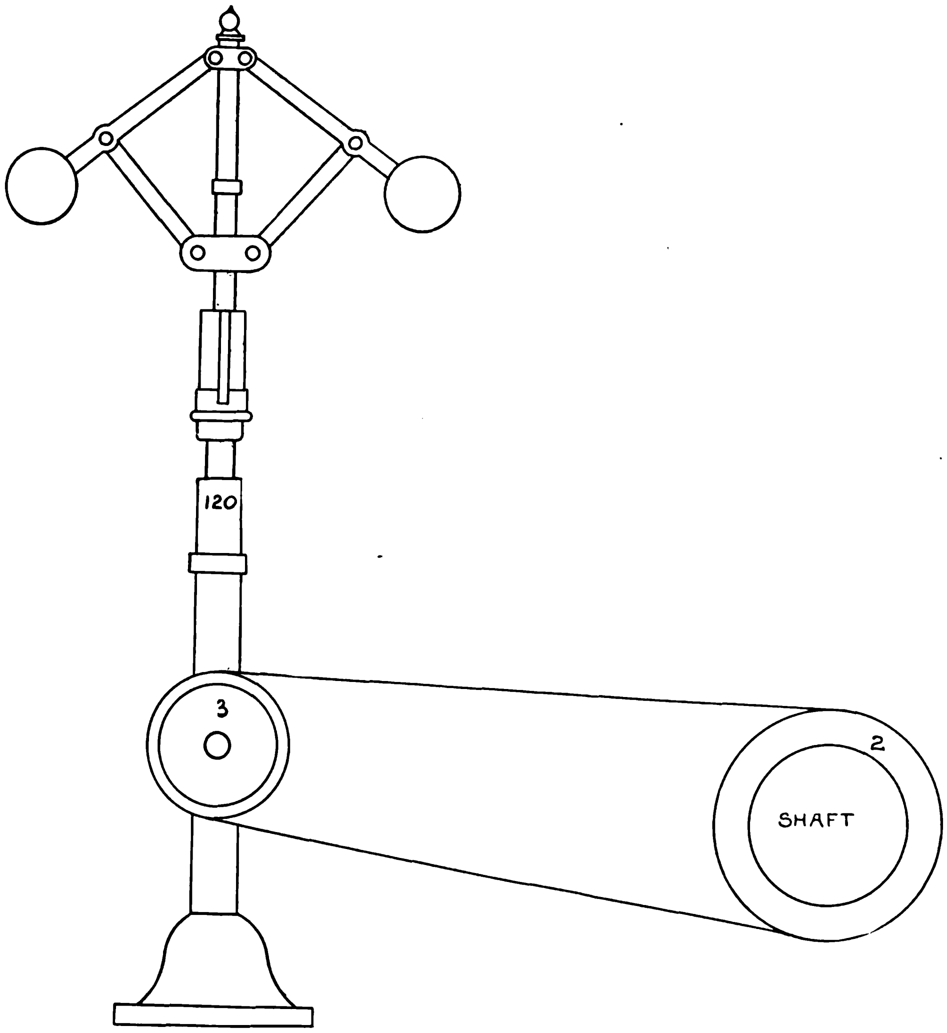

FIG. 4.

The speed of line shaft must not be changed, therefore the main pulley will be made larger, as that is probably the easier way to secure desired results. Suppose that the flywheel is 15 feet in diameter and while it revolves 70 times per minute, the line shaft should run 300 in the same time. The diameter of main pulley is then 15 × 70 ÷ 300 = 3.5 feet. The speed of engine is raised to 90, therefore the main pulley must be made 15 × 90 ÷ 300 = 4.5 feet in diameter.

When such a change was to be made in "the good old times," it was customary to bore many holes through the rim of pulley and bolt on wooden blocks made so as to nicely fit the circle. If one course was not sufficient, more was fastened to this until the required diameter was secured. This plan is all right so long as the blocks do not shrink and work loose, which they are almost sure to do sooner or later, thus becoming a constant nuisance, and sometimes a source of danger to all concerned.

The modern way is to take bolts out of the main pulley, if made in halves, or split it off if made solid, and put on a new steel pulley with wrought-iron rim. As this is in halves it requires but little time to make the change.

BLAST FURNACE GAS ENGINES FOR ELECTRIC POWER GENERATION.*

One of the largest generating stations in which the motive power is supplied by gas engines using the waste gases from the blast furnaces is that erected at the Phœnix Iron and Steel Works in Laar, near Ruhrort, Germany. By the courtesy of the management we are able to publish a brief description of the installation. At present the generating plant consists of three 1,000 hp. sets, while three other sets of 800 hp. each are in course of erection and are expected to run this spring. These gas engines are directly coupled to three-phase alternators, built by the Allgemeine Elektricitats-Gesellschaft of Berlin. The larger sets run at a speed of 100 revolutions per minute, but the three 800 hp. sets are to run at 140 revolutions per minute, this speed being chosen to enable the use of existing dynamos.

Fig. 1 shows the approximate calorific value and composition of various kinds of power gases used for gas engines. The production of every ton of crude iron liberates, we are informed, about 88,000 cubic feet of blast furnace gas, having the composition shown in the diagram and a calorific value of some 85 to 110 B.T.U. per cubic foot.

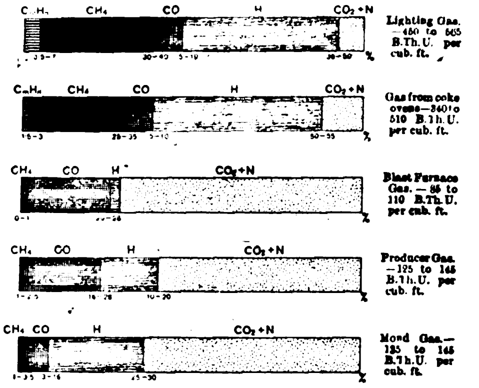

FIG. 1.

Charts Showing Composition of Various Gases.

After leaving the furnace, the gas is freed from its coarser impurities by passing through a number of ventilators into which water, in form of a spray, is injected. The gas is then forced by two other ventilators into the scrubber plant, where it first passes through two cylinders against a finely divided stream of water, and then flows through two coke scrubbers into the main gas pipe. After leaving the scrubber plant, it is stated that one cubic foot of gas contains only about 0.00875 grain of dust and from 4 to 6.5 grains of water.

The gas main runs along one side of the engine room, a separate pipe connecting it with each of the gas engines, which are placed side by side in the building. Each of these short connecting pipes terminates in an iron receptacle, interposed for steadying purposes. From these the gas flows to the mixing chambers on top of the engine. Fresh air is drawn into the mixing chamber from a system of underground tunnels. Current for the electric ignition is normally taken from the continuous current lighting mains, but a storage battery is provided as a stand-by and may readily be switched on to the ignition device by a two-way switch.

The engines were built by the Nurnberger Maschinenbau-Gesellschaft, and are illustrated in Figs. 2, 3 and 4. They work on the Otto cycle, but with two double-acting cylinders mounted in tan-

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*From the "Electrician," London.

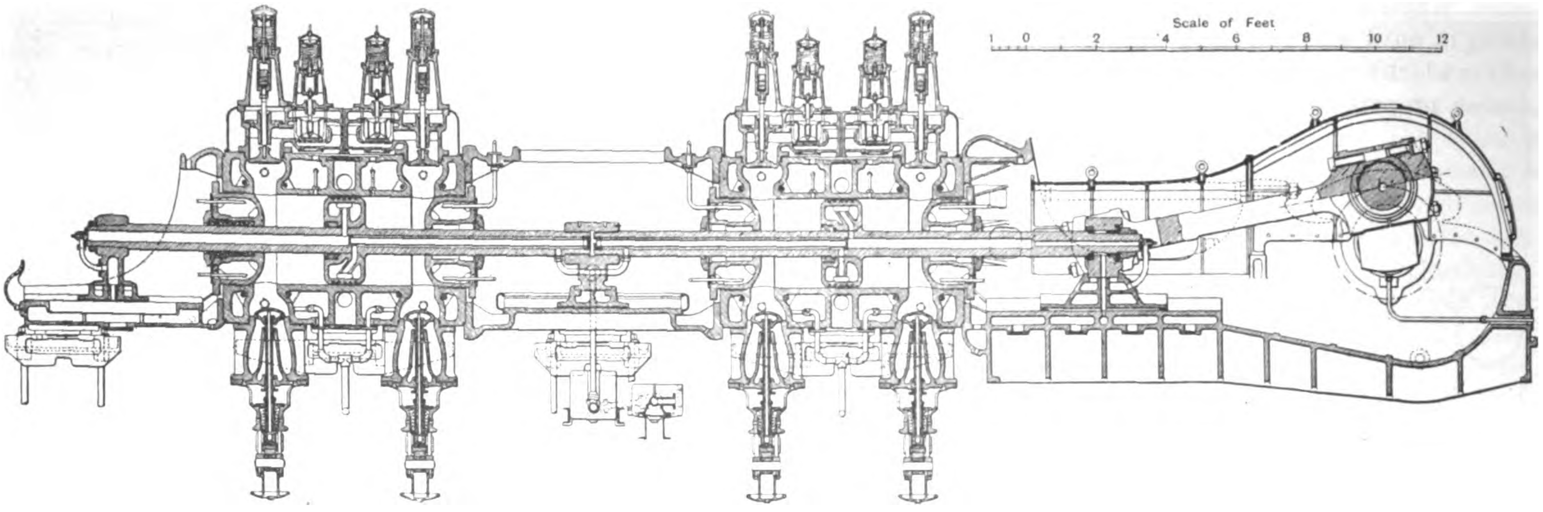


Fig. 2.—Section Through Phœnix Gas Engine.

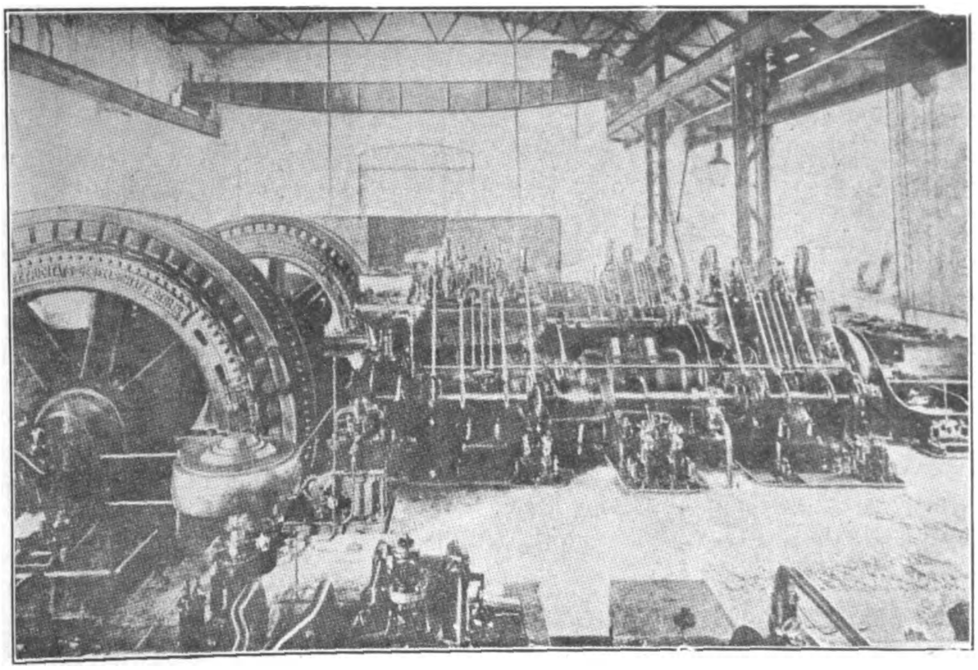


Fig. 3.—1,000 hp. Generating Sets at the Phœnix Steel and Iron Works.

dem. In order to diminish the thickness of the piston rods as much as possible they are machined in such a way as to be curved slightly upwards before weighed down by the pistons. The weight of the latter is just sufficient to straighten the rod when the piston is at the center of its stroke. In order to facilitate access to the crosshead the cast-iron frame which supports the crank shaft bearings is built low, but is strengthened by substantial stays of round iron, as shown. Since the principal pressure on the crosshead has a downward direction, it was only necessary to provide lower slide bars, but any upward motion of the crosshead is made impossible by suitable guides. To avoid all deformation the cast-iron cylinders are symmetrical in form, and the water jackets are provided with a number of large openings for facilitating the removal of deposits. To obtain perfect cooling the water jackets are so arranged and dimensioned that the incoming cooling water first flows quickly past the hottest parts of the engine, and then gradually slows down as the cooler parts are reached. The covers at each end of the cylinders are also water-cooled but they can be easily removed leaving the interior of the cylinders and the valves open for inspection and cleaning. At each cylinder end there is an inlet valve at the top and an exhaust valve at the bottom, the latter being water-cooled. The piston is as short as compatible with safety, and is fitted with piston rings of cast-iron. It, too, is artificially cooled, the water being conducted to and from it through the piston rod, which is hollow and of crucible steel. The bearings of the crank shaft, the glands of the piston rods and the slide bars are lubricated by oil under pressure. Each gland has its own oil pump. The main bearings as well as the motion block of the crosshead are lined with white metal. All the valves are of the "poppet" type and the speed of the engines is governed by varying the explosive mixture. The valves are actuated by a lever arrangement, which itself is set in motion by a number of eccentrics. These eccentrics are keyed to the half-time shaft which carries a small flywheel of its own and is driven through gearing from the main shaft. There are special oil pumps for lubricating the cylinders and for lubricating the spindle of the exhaust valve. The lubrication of all the external parts, however, is done by gravity, the oil being fed to the different parts through large sized tubes from a common tank fixed in a high position. All superfluous oil is collected in a tank in the cellar, cleaned from all coarse impurities and pumped back into the oil tank in the engine room. Grease is used for lubricating the eccentrics and parts of the governing mechanism.

The cooling water is fed to the different parts under a pressure of about 20 feet, but special pumps are required for forcing the water into the moving shaft and piston. The cooling water which flows out of the engine at various points may be regulated in volume at these different points so as to obtain the desired cooling with the minimum of water. There is also a valve in the main water pipe which is used when starting or stopping the engine. For an initial temperature of the water of about 60 degs. F. and a final temperature of some 105 degs. F. the quantity of cooling water required per brake horse-power hour is stated to be about 6½ gallons.

The engines are started with compressed air.

It is claimed that every brake horse-power hour produced by the engines corresponds to an expenditure of from 8,700 to 10,300 B.T.U. only.

The dynamos driven by these gas engines generate three phase current at 2,000 volts and 47 cycles per second. They work in parallel and supply electricity for power and light to the various parts of the works, where the pressure is reduced to 200 volts by transformers. A

1,200 hp. motor (capable of withstanding 50 per cent. overload) is being installed, in addition, for driving the rolling mills. It will be supplied with current directly from the 2,000 volt mains, and will run at 130 revolutions per minute at full load. The motor is directly coupled to the finishing rolls, but drives the roughing-down mill by ropes. The rolls—which produce light mining rails, sleepers, angle iron and joists of all descriptions, from blooms weighing 800 pounds to 2,200 pounds and of 8 square inches section—consist of roughing-down rolls and one finishing train. The roughing-down trains are of the three-high type with one housing, and have rolls 2 feet in diameter which rotate at 100 revolutions per minute. The finishing train, on the other hand, is of the three-high type with three housings. Its rolls have a diameter of 1 foot 8 inches, and rotate at 130 revolutions per minute as already mentioned.

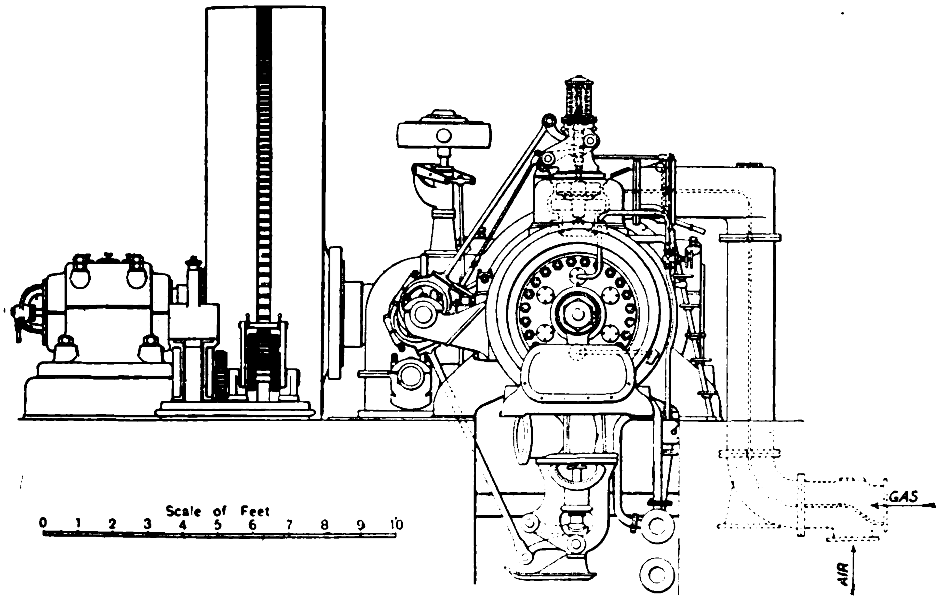


Fig. 4.—End View of Phœnix Gas Engine.

ELECTRIC SMELTING OF IRON AND STEEL.

Before the London Faraday Society at its last meeting a paper on "Recent Developments in Electric Smelting in Connection With Iron and Steel" was read by Mr. F. W. Harbord, who acted as metallurgist to the Canadian Government Commission which went to Europe last year to investigate thermo-electric processes. The author divided electric smelting furnaces into three main classes—induction furnaces, resistance furnaces and arc furnaces. The first type is specially adapted for melting rather than smelting; the others can be adapted for either purpose.

(1) INDUCTION FURNACES.

The best known furnace of this type is the Kjellin furnace. This is, in effect, a step-down transformer, in which the contents in the hearth form the secondary circuit of the transformer. Any grade of steel, from 0.10 to 1.50 per cent. carbon can be produced in this furnace, but high-class materials must be used, as there is no elimination of impurities. The furnace at Gysinge, in Sweden, which has been in operation since 1900, is now of 175 kw. capacity, and its output is 5.2 to 5.5 tons per 24 hours. The furnace absorbs from about 0.13 to 0.16 EHP.-year per ton of ingots, according to the carbon content of the product.

(2) RESISTANCE FURNACES.

(a) The Heroult Furnace.—A four-ton furnace at Kortfors, in Sweden, and a somewhat smaller one at La Praz, in France, are producing high-quality steel on a considerable scale. The furnace is a tilting one and is basic lined; two large adjustable electrodes pass vertically through the roof. In this furnace ordinary steel scrap can be converted into steel of the highest quality, the impurities being removed by suitable fluxes. Steel varying from 0.079 to 1.000 per cent. carbon is made with perfect ease. At La Praz an alternating current of 4,000 amperes and 110 volts is used. The furnace absorbs about 0.111 EHP.-year per ton of ingots in the case of low-carbon steel and about 0.17 EHP.-year for high-grade carbon steel.

(b) The Keller Furnace.—This is similar to the Heroult furnace, differing only in details. The author saw tests made with a 35-cwt. experimental furnace at Livet. Common scrap was the raw material and the energy absorbed was about 0.120 EHP.-year per ton of ingots.

(c) The Resistance Furnace for Direct Smelting from the Ore.—Experiments made at Livet in the Keller furnace demonstrated the possibility of making pig of the most varied composition. The type of furnace is identical with that used for making iron alloys, such as ferro-chrome, ferro-tungsten and ferro-silicon. The furnaces at Livet are vat-shaped and connected at their lower ends by a central well; four are usually grouped together. The current used in the trial runs varied between 10,600 and 12,000 amperes, at voltages from 63 to 68, and the energy absorbed was 0.25 hp.-years per ton of pig for a white iron containing little silicon and manganese, and 0.53 hp.-years for a grey iron more silicious. The coke used averaged 767 pounds per ton of pig-iron produced, and the estimated cost of electrodes was 87 cents per ton of iron.

At Livet 45 to 60 per cent. ferro-chromes and 25 to 80 per cent. ferro-silicons are made regularly. For such high-grade alloys the electric furnace is more economical than the blast furnace.

The Gin Process.—In this it is proposed to dispense with carbon electrodes, using instead large water-cooled block terminals, which lead the current into a long, basic-lined narrow channel, forming the furnace hearth. The author does not know whether the process has been tried on a commercial scale.

(3) ARC FURNACES.

The heat is obtained from direct radiation from the arc, and by reflection from the roof and sides of the furnace.

(a) The Stassano Furnace—The latest type at Turin is a five-ton furnace (per 24 hours) and absorbs 4,900 amperes at 150 volts, the current being distributed between two arcs (and therefore four electrodes) which meet at the center of the furnace. The furnace is lined with magnesia bricks. Steel is produced direct from the ore (pure hæmatite) in one furnace. Reduction is effected only by the carbon, which, with the ore, is moulded into briquettes, and a practically pure iron can be obtained. The energy consumption is 0.186 EHP.-years per ton of steel, and the consumption of electrodes 5 kg. per ton of steel.

(b) The Harmet Process—In one form of furnace the inventor melts oxides of iron in a vertical shaft by means of producer gas, and reduces them by solid incandescent carbon; in another form carbonic oxide is his chief reducing agent. The process has not yet been experimented with on a commercial scale.

GENERAL CONCLUSIONS.

(a) Steel, equal in all respects to the best Sheffield crucible steel, can be produced even in this country, either by the Kjellin, Heroult, or Keller processes, at a cost considerably less than the cost of producing a high-class crucible steel, assuming electric energy to cost $50 per EHP.-year.

(b) At present, structural steel, to compete with Siemens or Bessemer steel, cannot be economically produced in the electric furnaces, and such furnaces can be used commercially for the production of only very high-class steel for special purposes.

(c) Speaking generally, the reactions in the electric smelting furnace are similar to those taking place in the blast furnace. By altering the burden and regulating the temperature by varying the electric current, any grade of iron, grey or white, can be obtained and the change from one grade to another is effected more rapidly than in the blast furnace.

(d) Pig iron can be produced on a commercial scale at a price to compete with the blast furnace, only when electric energy is very cheap and fuel very dear. With electric energy at $10 per EHP.-year, and coke at $7 per ton, the cost of production is approximately the same as the cost of producing pig iron in a modern blast furnace. Under ordinary conditions, where blast furnaces are an established industry, electric smelting cannot compete; but in special cases, where ample water-power is available, and blast furnace coke is not readily obtainable, electric smelting may be commercially successful.

COMMUTATION OBSERVATIONS BY OSCILLOGRAPH.

Mr. J. K. Catterson-Smith, in his paper presented in England before the Birmingham section of the Institution of Electrical Engineers on March 15, gave figures of records taken with a Duddell pattern oscillograph, of the actual current in one particular coil on the armature of a small four-pole Westinghouse rotary converter which was used as a 6 hp. shunt motor running at 1,200 r.p.m. on a 110 volt circuit. The output was measured by means of a brake on the pulley, and as far as possible observations were made at full load, but the time taken in recording the shape of the commutation curve in the brush-shifting experiments, the burning up of the brake band and the excessive sparking on the commutator, made it imperative to work at half load. The method for observing the current was this: the armature circuit was cut at a point remote from the commutator, and the two ends of the coil thus exposed were connected to a pair of slip rings, the brushes on these rings being joined together by a strip of manganin sufficient to give about ¼ to ½ volt drop at full load; the oscillograph was connected across this strip and thereby showed the current in that particular coil at any instant.

The curves obtained showed very clearly the desirability of using as narrow a brush as possible on a motor with a large polar arc in which the neutral zone is small. A wide brush soon has one or other edge in contact with conductors in a comparatively strong field, which will certainly produce heavy short-circuited currents. The increased loss which results through a wrong brush position, and which goes in increased heating of the armature and commutator, was indicated by certain of the curves.

The calculation of the reactance voltage of a coil undergoing short-circuit is now usual in designing a continuous current motor. Mr. Catterson-Smith's commutation curves showed that in all probability the sine curve is rarely to be met with, and that the method of calculating the reactance voltage gives little more than a guiding figure; however, as a guide, that figure is very useful, especially in the comparison of similar types of machines.

The best practice was stated to be to design a machine with its reactance voltage less than the brush drop whenever possible, especially with reversible motors having a fixed brush position. The reactance voltage of small machines with stiff fields should be kept below 2.0 volts, which may be increased to 3½ for large machines; but for variable speed motors, etc., which have to work with very weak fields, there is no reversing field to help the commutation, and the reactance voltage must be kept below 1.0. Of course these figures do not apply to machines having special commutation poles.

COMMERCIAL SUCCESS.

It has been remarked, and with truth, that one of the secrets, perhaps it may be termed the chief secret, of commercial success is enthusiasm, wisely directed, of course. The business man who strives to invest his duties, day by day, with the spirit of enthusiasm, may be said to give his day's task a good "set-off," as it were, while he is likely to get through his work with less expenditure of nerve-force, and with a greater degree of pleasure to himself than if he started in an indifferent or dull frame of mind, as many business men are, unfortunately, so often accustomed to do.

The foregoing observations may truthfully be said to apply to every branch of business, including that of engineering. This is a "point" which the young engineer should take careful note of. He should remember that our great engineers and inventors did not achieve distinction merely by dogged application to the task on hand, but likewise by the enthusiastic way in which they, as a rule, went about their respective work.

Some of our eminent living engineers, electricians and inventors (whose names might easily be adduced), are noted for the jubilant spirit with which they invariably invest their labors. They appear to find a perennial pleasure in their work; and that is exactly what everyone, the academically-trained professional, commercial men, and artisans alike, ought ever to strive to do. They will thereby be able to find pleasure—nay, even delight—in the performance of their work, whatever it may be We are quite well aware of the fact (and it is an ugly fact, too), that many men are to-day pursuing a calling for which they have no particular liking. Such unhappy souls are frequently heard to say that "they do not care for the work, but it is the only kind of business that they are qualified for." Such individuals, and we fear they are somewhat numerous, are assuredly to be pitied.

It is a pity for any man to have to follow a trade or profession which does not lie to his heart. He is not likely to attain distinction, nor even ordinary success, in his own sphere of labor. There would be fewer of this type of worker in our midst at this present hour if parents studied the "bent" of their children's minds ere apprenticing them to a trade. The natural taste of a child should always be allowed due weight when determining upon their future life-calling. Indeed, we do not know but that it should rank as a primary element in the matter, that is, assuming that the youth or girl is physically and mentally qualified to pursue the particular line of business towards which his or her native bent of mind points.—"Engineering and Iron Trades Advertiser," Glasgow.

New Submarine Boat.

Several experiments have recently been made at Camogli, near Genoa, Italy, with a new submarine boat. The craft is intended to recover objects from the bed of the sea, and for this purpose is provided with powerful hooked arms worked by electricity. So far the greatest depth reached is 58 fathoms, and at this the men were able to breathe and work freely.

Nominations by the Institute.

The board of directors of the American Institute of Electrical Engineers nominated the following ticket for the coming annual meeting: For president, Schuyler S. Wheeler, of Ampere, N. J.; for vice-presidents, Charles A. Terry and Townsend Wolcott, of New York, and Gano S. Dunn, of Ampere, N. J.; for managers, C. C. Chesney, of Pittsfield, Mass., Calvert Townley, of New Haven, Conn., Bancroft Gherardi, of Brooklyn, and Charles L. Edgar, of Boston; for treasurer, George A. Hamilton, of New York; for secretary, Ralph W. Pope, of New York.

Electrical Horseshoe Magnet.

A dispatch from Boston, Mass., says that experiments have been made recently at the Allston shops of the New York Central Railroad with an electrical horseshoe magnet attached to a set of locomotive driving wheels to determine the degree of magnetic resistance it was possible to exert. It was found that with the attachment employed the adhesion was increased fully 35 per cent. The Central will have 30 of its locomotives fitted with the device, so as to do away with the use of sand.

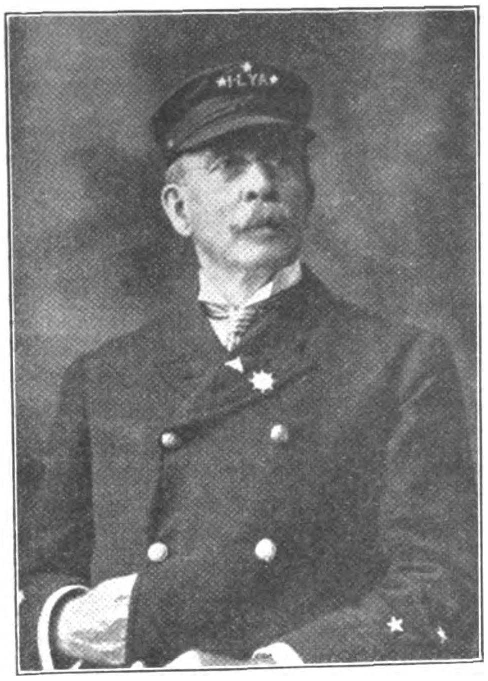
DEATH OF CHARLES C. WARREN.

Mr. Charles C. Warren, president of the Warren Electric Manufacturing Company of Sandusky, O., died at his home in that city on Wednesday, March 22, from a stroke of paralysis. He was nearly 70 years old.

Mr. Warren entered the electrical business in 1878 and from 1881 to 1890 he was the Western manager of the old United States Electric Light Company. He later managed the affairs of the United Edison Manufacturing Company in the West, outside of Chicago, until the fall of 1891, when he went with the Westinghouse Company.

In 1892 Mr. Warren together with his son, H. B. Warren, designed and patented an inductive type of alternating current generator, now well known as the Warren alternator. In 1896 the Warren Electric Manufacturing Company was organized and this company erected a plant at Sandusky for the purpose of building these alternators and other electrical machinery. Mr. Warren was president and general manager of this company at the time of his death and since the beginning has managed its affairs with an eye to the welfare of all connected with the company, whom he considered as members of his industrial family alike interested with himself in the common good.

He was an enthusiastic yachtsman, owning one of the finest yachts on Lake Erie, the Wemco II, and was honored with the office of commodore of the Interlake Yachting Association, composed of yacht clubs of Lake Erie. He was a Free Mason and a member of the Order of Elks, was identified with many local enterprises in Sandusky, and his death will be a serious loss to that city. He is survived by his wife and one son, Mr H. B. Warren.



CHARLES C. WARREN.

Large Cable Contract.

The Safety Insulated Wire & Cable Company has been awarded the contract for the cable for the Alaskan line and the cable for the fire control system, at its bid of $150,000.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MARCH 28, 1905.

Electric Railways and Appliances.

785,758. Electric-Railway System and Conduit. George W. Olinger, Orchard, O. Filed June 19, 1903.

785,840. Car-Fender. Charles H. Turner, New York City, assignor of one-half to Will O. Turner, same place. Filed June 25, 1904.

785,891. Railway Block Signal Apparatus. Allen B. Kendall, Maywood, Ill. Filed Oct. 17, 1904.

785,909. Electric-Railway System. John O. McDonald, New York City. Filed Feb. 9, 1904.

786,148. Signal System for Electric Railways. Greenleaf W. Pickard, Amesbury, and Harold J. W. Fay, Westboro, Mass., assignors to the American Telephone & Telegraph Company Filed Jan. 28, 1905.

786,188. Trolley. James L. Brownlee, Pittsburg, Pa. Filed June 10, 1904. Renewed Jan. 31, 1905.

786,209. Electric Railway Signaling System. John D Gordon, Riverside, Cal. Filed May 5, 1904.

786,219. Trolley. Sando Kacso, Allegheny, Pa., assignor of one-half to David Hollander, same place. Filed Dec. 9, 1904.

Electric Lights and Appliances.

85,980. Electric-Arc Lamp. Ralph Scott, Wilkes-Barre, Pa., assignor of one-half to Marcus A. Miller, New York City. Filed Oct. 14, 1903.

785,997. Incandescent-Electric-Lamp Socket. George C. Baillard, Brooklyn, N. Y., assignor to the General Electric Company. Filed May 28, 1902.

786,231. Electric Lamp. George P. McDonnell, St. Louis, Mo., assignor to the American Electric Company, East Orange, N. J. Filed Jan. 5, 1905.

Electrical Machinery and Apparatus

785,700. Electric-Conductor Support. Johan M. Andersen, Boston, Mass., assignor to the Albert & J. M. Anderson Manufacturing Company, Portland, Me. Filed Jan 5, 1905.

785,703. Power-Transmitting Mechanism. William J. Bayrer, Hartford, Conn., assignor of one-half to Frederick R. Boynton, same place. Filed Feb. 29, 1904.

785,712. Electric-Cable Joint. Donald J. Chisholm, East Hampton, N. Y. Filed May 11, 1904.

785,731. Means for Converting Electrical Currents for Induction-Motors. Christian F. Heinkel, Cleveland, O. Filed Aug. 4, 1904.

785,797. Thermal Cut-out for Electrical Circuits. Frank B. Cook, Chicago, Ill. Filed March 9, 1904.

785,816. Indicating Apparatus for Motor-Vehicles. David Mason, New York City, assignor to John A. Woods, Brooklyn, N. Y. Filed Aug. 25, 1903.

785,817. Controlling Apparatus for Motor-Vehicles. David Mason, New York City, assignor to John A. Woods, Brooklyn, N. Y. Filed Aug. 25, 1903.

785,863. Electric Time-Switch. William B. Coulter, Waterbury, Conn. Filed Nov. 11, 1904.

785,948. Power-Transmission Mechanism. Magnus Hendrickson, Chicago, Ill., assignor to Jacob Lauth, same place. Filed April 4, 1904.

785,949. Double-Throw Electric Switch with Indicator. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company. Filed July 11, 1903.

785,970. Means for Regulating Electric Circuits. Walter S. Moody, Schenectady, N. Y., assignor to the General Electric Company. Filed July 26, 1902.

785,994. Rheostat for Starting and Controlling Electric Motors. William C. Yates, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 14 1904.

785,995. Winding for Three-Phase Motors. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 19, 1904.

786,008. Air-Brake Control. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 13, 1904.

Telephones and Telephone Apparatus.

785,728. Telephone System. Adolph C. Gilgen, Passaic, N. J., assignor to the New York Automatic Telephone Company, same place. Filed June 11, 1904.

785,754. Telephone-Exchange Apparatus. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company. Filed May 27, 1901.

Miscellaneous.

785,803-804. Art of Transmitting Intelligence and System of Transmitting Intelligence. Cornelius D. Ehret, Rosemont, Pa. Original application filed Feb. 10, 1902. Divided and last application filed July 8, 1902.

785,832. Electrode for Electric Furnaces. Edgar F. Price, George E. Cox and James G. Marshall, Niagara Falls, N. Y., assignors to the Union Carbide Company, same place. Filed Oct. 19, 1903.

785,941. Compound Relay. Stephen D. Field, Stockbridge, Mass. Filed Jan. 14, 1905.

785,962. Production of Boron by Electrolysis. John A. Lyons and Edward C. Broadwell, Chicago, Ill. Filed Sept. 16, 1903.

786,005. Electric Protector Apparatus. Frank B. Cook, Chicago, Ill. Filed April 11, 1904.

786,016. Combined Electric and Mechanical Signal Apparatus for Elevators. William T. Dulany, Jr., Brooklyn, N. Y. Filed May 11, 1904.

786,017. Starting-Rheostat. Edgar F. Dutton, Schenectady, N. Y., assignor to the General Electric Company. Filed Nov. 13 1902.

786,024. System of Distant Electrical Control. Joel Gomborow, Lynn, Mass., assignor to the General Electric Company. Filed 15, 1904.

786,132. Wireless Telegraphy. Guglielmo Marconi, London, Eng., assignor to Marconi's Wireless Telegraph Company, Limited. Filed Oct. 13, 1903.

786,146. Electric Hammer. Louis Paulero, Petersburg, Va. Filed Sept. 22, 1904.

786,221. Process of Electrodepositing Metals. Edward D. Kendall, Brooklyn, N. Y., assignor of one-third to Edward N. Dickerson, Stovall, N. C. Filed Oct. 28, 1903.

THE TELEPHONE WORLD.

Telephone Extension for Northern New York.

The Clinton Telephone Company is preparing to extend Independent telephone lines throughout Northern New York, and will by early summer be giving service with the towns in the northern part of Clinton and Franklin Counties. The company has recently acquired the property of the Malone Independent Telephone Company, which gives control of the Independent service in Franklin County. Arrangements have been completed for building lines from Plattsburg to Champlain, Rouses Point, Mooers, Ellenburg, Chateaugay and Malone, thus giving complete service with the entire section.

The council of the village of Richwood, O., has refused for the second time to grant a franchise to the Central Union Telephone Company for an exchange in that village. It is said that the reason the council is not willing to grant a franchise is because Richwood men are interested in the Independent Telephone Exchange there and are opposed to another system.

The St. Louis, Mo., County Telephone Company has disposed of all its bonds issued so far for the purpose of constructing the system to J. H. Murphy. The details of the deal were completed at a meeting of the directors lately held at Clayton. It was also agreed that the capital stock of the company should be increased from $100,000 to $200,000. Webster Groves and Kirkwood will be supplied next.

The Owingsville, Ky., Telephone Company, owned by Henry Watson, of Mt. Sterling, in connection with W. J. Felt, of Salt Lick, will erect a telephone line from Salt Lick to Owingsville at once, connecting the latter place with all long-distance lines.

Clarence Kirwan, representing the Chesapeake & Potomac Telephone Company, of Baltimore, Md., has filed an application with the county commissioners for permission to extend the company's lines through the Fourth and Fifth districts.

The Keystone Telephone Company has issued a statement saying that it now has 17,000 'phones in use in Philadelphia, and that earnings are far ahead of last year. Its finances are in very much better shape than they were formerly.

The stockholders of the Jacksonville, Telephone Company have decided to immediately extend their line to Lonoke, Ark., and put in an exchange there.

The Wausau, Wis., Telephone Company has closed a contract for a 700-drop automatic telephone system. The change means an outlay of $30,000.

An Independent telephone line is being constructed by the farmers living east and south of Bristol, S. D.

A rural telephone company has been organized in Big Lake, Minn., and $1,500 in stock subscribed.

South Bend, Ind., is to have an automatic telephone system.

Rural Line for Fourteen Towns.

Citizens and farmers of the towns near New Ulm, Minn., have organized the New Ulm Rural Telephone Company. The purpose of the company will be to establish rural telephones in 14 towns adjoining New Ulm, in the counties of Brown, Nicollet and Blue Earth. Articles of incorporation were adopted, and the capital stock will be $50,000, divided into 2,000 shares. A large portion of the stock has already been subscribed. Officers were elected as follows: President, Philip Liesch, of New Ulm; vice-president, Alexander Russell, of West Newton; secretary, A. J. Vogel, and treasurer, Otto Schell, both of New Ulm. A director for each of the 14 towns was also elected. New Ulm will be the central point from which the rural lines will radiate. Steps were taken to begin the construction of the line, and it is expected to have it completed some time next summer.

At present the Minnesota Central Telephone Company, with headquarters at Wilmar, occupies the field at New Ulm. It is the purpose of the new company to connect with or purchase the local exchange. If these plans should fail, another local exchange will be built.

The Farmers' Mutual Telephone Company, having as its object the connection of the rural sections of Whatcom County, Wash., was lately organized. Ed. Brown, of Custer, is president; W. H. Townes, of Lynden, secretary, and J. C. Gillies, of Nooksack, treasurer. It is a co-opertive, pay-as-you go proposition, and no indebtedness is to be incurred. Work has for several weeks been progressing under the temporary organization, and already 50 miles of poles have been set by the farmers between Everson and Sumas, Sumas and Lynden, Custer and Ferndale, and Sumas and Nooksack. It was recently decided to place an order for two tons of wire, which will stretch about 50 miles. This will cost about $6 a mile, it is estimated. In Bellingham, Minn., and the rural towns, the Farmers' line is to connect with the Sunset Company's system. The company is working as an association.

A new enterprise to be known as the Oaks Corners, N. Y., Telephone Company is being carried into effect. The poles will be set up shortly. The system will extend a few miles in each direction, so that most of the residents will be in communication with Oaks Corners, and thence to many other places. Frank Wood is the president.

According to a recent announcement made by the Providence, R. I., Telephone Company, the rates for extension telephones will be reduced to $6 a year to subscribers, or just one-half of the present rate.

Thousands of dollars will be spent by the Mutual Telephone Company, of Shelbyville, Ind., in extensive improvements, among those contemplated being the installation of an entirely new underground system.

An Independent telephone company, capitalized at $15,000, has been organized at Milton, Ky.

A 25-year franchise has been granted to the Milford, Ia., Telephone Company.

Two Companies Consolidate.

The home office of the Wayne County Telephone Company, which has been in Clyde, N. Y., since the formation of the company 10 years ago by the Bishop Brothers, is to be removed to Lyons and consolidated there with the main office of the Wayne-Monroe system. This is a move in the direction of making the Clyde Independent telephone system in connection with the Wayne-Monroe system one of the most complete and satisfactory to be found anywhere.

A central energy plant to cost $4,000 is to be established in Lyons.

The village of Newport, N. Y., at a recent special meeting of its trustees, granted a franchise to the County Telephone Company, of Herkimer, a branch of the Utica Home Telephone Company, permitting the company to erect poles and wires in its streets. The company will build an exchange at Newport, from which the territory of the West Canada Creek Valley will be served. The villages of Cold Brook, Middleville and Poland will be reached by trunk lines. The exchange will have connections for 400 'phones. Construction work will begin as soon as conditions are favorable.

The Wyandotte County, Kan., commissioners have granted to the Monticello Telephone Company the right to string wires across the Bonner Springs bridge. This will give better telephone communication between the farmers on either side of the Kaw River.

At the annual meeting of the stockholders of the American Telephone & Telegraph Company, last Tuesday, the retiring board of directors was re-elected. The by-laws of the company were changed to conform with the laws, but otherwise only routine business was transacted.

The McLaurine Telephone Company, of Oak Grove, Mo., will install an exchange at Grain Valley, Mo. It will connect with Oak Grove, Lone Jack, Tarsney, Grain Valley and Blue Springs.

The merchants and farmers of Houstonia, Mo., have formed a telephone company and will put in an exchange there. M. P. Tuck is president, and Dr. C. L. McConnell, secretary.

The Churchville, N. Y., Home Telephone Company is making rapid and satisfactory progress with its line in that village.

The Commercial Club of Hanley Falls, Minn., will organize a telephone company.

Telephone Incorporations.

The Bondville Telephone Company, Bondville, Ill. Capital stock, $2,500. Incorporators: William H. Scott, George A. Keller and Otis W. Norton.

The Farnhamville Mutual Telephone Company, Farnhamville, Ia. Capital stock, $10.000. Incorporators: Charles Rose and others.

The Colebrook Telephone Company Colebrook, O. Capital stock, $3,000. Incorporators: V. G. Bedell, C. H. Turner, S. R. Cobb, J. L Allen, J. E. Diffon and S. L. Fobes.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Allentown, Pa.—A well organized movement is on foot here to establish a new electric light company.

Alpena, Mich.—The Alpena Power Company contemplates extensive improvements in the electric lighting plant.

Altoona, Pa.—The Citizens' Electric Light & Power Company will build a large number of extensions to its lines during the coming summer.

Amenia, N. Y.—The Morgan & Wyman Electric Light & Power Company, capitalized at $6,000, has been incorporated by C. B. Morgan, Cora Morgan, of this place, and C. S. Wyman, of Dover Plains.

Bartlett, Tex.—R. S. Decker has applied for a franchise to install an electric light plant here.

Colorado Springs, Col.—The corporation which recently consummated a deal for the purchase of the Seven Falls & South Cheyenne Canon for $225,000, has announced that, among improvements proposed at the Seven Falls, will be a colored electric illumination that will make its resort even more wonderful at night than it is in daylight. The illumination will be installed before June 1.

Columbus, O.—The Pan Handle Railroad Company, of this city, will expend $30,000 in improvements. An electric light plant will be erected by the company at Louisville, Ky.

Danville, Ky.—The Danville Light, Power & Traction Company, with a capital of $50,000, has been incorporated to light this city with electricity.

Fremont, Mich.—Claude T. Lloyd has bought the supply department of the municipal lighting plant here, and will carry a full line of electric supplies for the Western Michigan trade.

Grand Forks, N. D.—Bonds in the sum of $30,000 may be issued for the construction of a commercial electric light plant in this city. For further information address Mayor George F. Duis.

Green Bay, Wis.—The supervisors of Brown County are contemplating the erection of an electric lighting plant at the county farm.

Hope, Ind.—The Ryan Construction Company, of Indianapolis, has been awarded the contract to build and equip an electric light plant in this city.

Mason City, Ill.—The question of municipal ownership of the electric light plant here will be submitted to a vote of the people.

Muncie, Ind.—The Citizens' Electric Light Company, capitalized at $200,000, has been formed with the following directors: Charles E. Hinkley, H. J. Keller, W. G. Braun, C. Roy Hathaway and William F. Warner.

Newberry, S. C.—This city contemplates installing new machinery at its electric light plant, increasing the capacity.

Norfolk, Va.—The Norfolk & Western Railway Company will install a new system of electric lighting.

Ocala, Fla.—The Florida Power Company has been incorporated with a capital of $300,000, to construct and operate a waterworks and electric light plant. M. Camp is president.

Oregon City, Ore.—The Portland General Electric Company has applied to the city council for a franchise for the transmission of electric light and power.

Sioux City, Ia.—Samuel McRoberts and Edward Tilden propose to install an electric lighting system and a heat distributing system.

Starkville, Miss.—The citizens will vote April 15 on the issuance of $8,000 of bonds for improvements to the waterworks and electric light plant.

Williamsburg, Mass.—An attempt may be made to get an order through the city council authorizing the Williamsburg Electric Company to run its wires on to the village of Leeds, so that several streets can be supplied with incandescent lights

Woodbury, N. J.—The Gloucester County Electric Company, of this place, with a capital of $50,000, has been incorporated by Enos R. Artman, Manasses K. Twichler, Daniel G. Endy and others.

STREET RAILWAYS.

Bellefontaine, O.—The receivers of the Urbana, Bellefontaine & Northern Traction Company will improve the road at once and put it in good repair.

Buffalo, N Y.—It is predicted that within six months this city will be connected with Indianapolis by trolley.

Danbury, Conn.—It is reported that the Danbury and Harlem electric trolley railroad from this city to Golden Bridge, N. Y., will be built and put in operation this summer. The Philadelphia Industrial Company, it is said, is now backing the road.

Dayton, O.—The Dayton & Northwestern Railway Company, recently incorporated with $100,000 capital, will construct an electric line from this city to Kenton. Hugo Cook, M. W. Chambers and others, are interested.

Evansville, Ind.—Plans are under consideration by the owners of the Evansville & Princeton Electric Railroad Company to construct a system of interurban electric railways this summer.

Findley Lake, N. Y.—The Findley Lake & State Line Street Railway Company, of this place, has been formed to construct 13 miles of electric railway in Chautauqua County. Its capital is $130,000, and directors, F. R. Nichols, Titusville, Pa.; I. A. Pond, Corry, Pa.; E. A. Austin, Cutting.

Hanover, Pa.—Civil engineers are surveying for the proposed extension of a trolley line from here to Littlestown.

Independence, Kan.—W. H. Nees, general manager of the Union Traction Company, has stated that the interurban electric road will build to Neodesha.

Salt Lake City, Utah.—Simon Bamber has presented to the council an application for an electric railway franchise.

Utica, N. Y.—The Hudson River Electric Power Company will construct a power house here which will furnish power for the Utica & Mohawk Valley Railway Company.

POWER PLANTS.

Baring Cross, Ark.—It is reported that the St. Louis, Iron Mountain & Southern Railway Company will make extensive improvements here, including the remodeling of its power plant, etc. W. T. Tyler, of Little Rock, is general superintendent.

Corona, Cal.—An engineer of the General Electric Company, of Los Angeles, has lately been here investigating the possibilities of utilizing the water of Lake Elsinore for electric power purposes, the water to be brought in a high line to Temescal and there dropped into Temescal Cañon. The power generated in the canon, it is assumed, could be transmitted to various parts of the valley for street railway and electric lighting purposes.

Nashville, Tenn.—The Tennessee Power Company, with a capital of $100,000, has been incorporated by Cornelius Ackerman, William B. Dinsmore, Jr., and others, to manufacture electricity.

Raubsville, Pa.—The electric light and power plant of the Lehigh Power Company, located between the canal and the Delaware River just below here, has been purchased by B. F. Fackenthal and Lee S. Clymer, of Riegelsville.

Shoshone, Idaho.—The Shoshone Power Company has been organized with Francis M. Lyman, of Salt Lake City, as president.

BIDS WANTED.

Chicago, Ill.—The Ford Manufacturing Company, of 109 West Madison street, is in the market for two 100 hp. boilers for its Vandalia, Ill., plant.

Hot Springs, Ark.—N. M. Moody, of this city, wants prices on electrical equipment for a 4-story hotel.

Janesville, Wis.—Sealed bids will be received until April 24, for lighting this city with electricity for a term of five years. A certified check for $3,000 is required. Address A. E. Badger, city clerk.

Knoxville, Tenn.—Sealed proposals will be received until April 15 for furnishing lights, miscellaneous, etc., for this city during the fiscal year. Address W. L. Trent, custodian.

Luverne, Ala.—The Luverne Electric Light & Water Company wants prices on machinery and equipment for an electric light plant.

Michigan City, Ind.—The United States Brick Corporation, of this city, is in the market for a 150 hp. boiler and a 100 hp. engine.

Morton, Ill.—Beyer Brothers, owners of the electric light plant here, are in the market for one 150 kw. 220 volt second-hand generator, and one 16 x 27 x 16 Westinghouse compound engine in first-class condition.

Osborne, Kan.—This town is in the market for a 15 hp. engine, a 20 hp boiler, a 100 feet steel tower and an 80,000 gallon tank. Address J. A. Fouts, city clerk.

Raleigh, N. C.—The Elks Home Construction Company, care of L. A. Mahler, this city, wants prices on electrical equipment.

Washington, D. C.—The Bureau of Supplies and Accounts will rcceive sealed proposals until April 25 for furnishing the Mare Island and Puget Sound Navy Yards with the following: Schedule 134, conduit, wire, signal bells, switches, transformers, insulators, incandescent lamps, motors, fuses, sockets, cut-outs and other electrical supplies. Schedule 135, motors and chemicals for electrical use. Applications for proposals should designate by number the schedules desired. Blank proposals can be obtained at the Navy pay office in San Francisco, or at the Bureau in this city.

NOTES FCR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15¼@15⅜c.; casting, 14⅞@15c.

The Toledo Railways & Light Company has declared an initial semi-annual dividend of 1 per cent., payable May 1.

The American Telephone & Telegraph Company has applied to the New York Stock Exchange to list $25,000,000 bonds.

The New Orleans Railways Company earnings now amount to about 5 per cent. on the new $10,000,000 of 5 per cent. preferred stock.

Industrial dividends in April will be the largest for this month in years. Declarations announced to date total about $24,000,000.

The New York & New Jersey Telephone directors have declared the regular quarterly dividend of 1½ per cent., payable April 15 to stockholders of record April 5.

A broker who claims to be well-informed as to the Philadelphia Electric-United Gas affairs is responsible for the statement that there is no deal between the two concerns.

An Albany, N. Y., dispatch states that before the final passage of the stock transfer bill it may be amended so as to make the tax $1 instead of $2 on each 100 shares sold or transferred.

The trustees of the Massachusetts Electric Companies have sold to Hayden, Stone & Co. $1,000,000 of Old Colony Street Railway and Boston & Northern Street Railway 50-year 4 per cent. bonds.

The sale of the Springfield (Mass.) Street Railway Company to the New York, New Haven & Hartford Railroad Company is not positively assured but present indications are favorable to the sale.

A special meeting of the stockholders of the Rochester (N. Y.) Street Railway Company will be held on Friday, April 7, to vote on the proposition to increase the capital stock of the company from $5,500,000 to $6,000,000 by the issue of 5,000 shares of preferred stock of the par value of $100 each. The stock will be offered pro rata to present stockholders at a price to be determined at the meeting.

The New York State Board of Tax Commissioners has increased the taxable valuation of the Brooklyn Rapid Transit Company $4,000,000 and the Metropolitan Street Railway Company an equal amount. The Manhattan elevated franchises sustain an increase of about $9,000,000, and the Subway franchises have been assessed for the first time at $9,000,000. The right to assess the Subway franchises is to be tested in the courts.

It is understood that the New York, New Haven & Hartford Railroad Company is a prospective purchaser of the Northampton & Amherst Street Railway, which was authorized Saturday morning to purchase on a share for share basis the Greenfield, Deerfield & Northampton and the Greenfield & Turner's Falls Street Railway Companies. The Northampton & Amherst Street Railway Company is authorized to issue 3,100 additional shares for purposes of exchange.

To learn what is invested in the gas business in New York is now the chief business of the Stevens Legislative Committee. As a result so far, Charles E. Hughes, chief counsel of the committee, arrived at about $27,000,000 as a fair valuation of the property. Surprise was occasioned by a statement that the Consolidated Gas Company, although it paid large dividends last year, actually had a deficit at the end of the year of $1,162,569.80.

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price April 1.
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	207
Manhattan Elevated Railway	167¼
Metropolitan Street Railway	122¾
Metropolitan Securities	87½
Ninth Avenue	197
Third Avenue	131¼
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	67⅝
Brooklyn City Railway	239
New Orleans Railway	4¼
Public Service Corporation (New Jersey)	141
Philadelphia.	
Consolidated Traction of New Jersey	83
Philadelphia Traction	100⅛
Union Traction	59
Boston.	
Boston Elevated	156
Massachusetts Electric Companies, com	22⅛
do. do. do. pref.	68¾
West End Street, com	97½
do. do. do. pref.	116½
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	10¼
do. do. pref.	45
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	17⅞
do. pref.	62
Electric Boat, com	41
do. do. pref.	78
Electric Lead Reduction	¼
Electric Vehicle, com	12⅛
do. do. pref.	24
Westinghouse, com	181
do. pref.	192
General Electric	185½
Boston.	
Edison Electric Illuminating	255
General Electric	185
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	45
do. do. pref.	113
Philadelphia.	
Electric Company of America	12
Electric Storage Battery, com	88
do. do. do. pref.	88
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	144½
Western Telephone Company	20½
New England Telephone Company	136½
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210¼
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93
Chicago Telephone Company	137¾
MISCELLANEOUS STOCKS.	
Otis Elevator Company	49
Consolidated Car Heating	64
Standard Underground Cable	200

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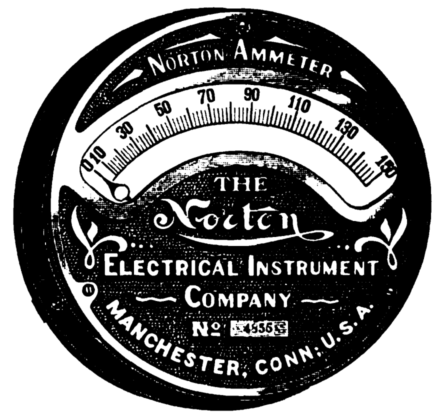
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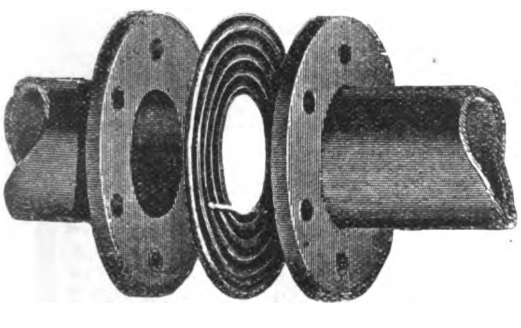

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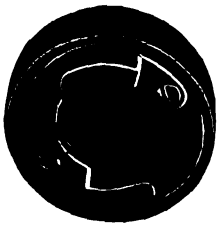

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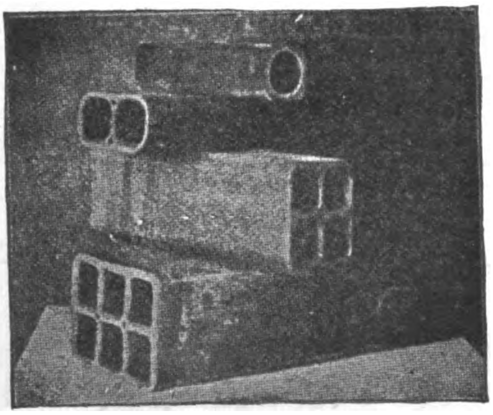

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ELECTRICITY.

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EDITORIAL NOTES.

Private Plant and Central Station Lighting.

A large private plant represents the equivalent of a central station; and a small central station the equivalent of a private plant. These instances have presented themselves in the case of the recent St. Louis Fair on the one hand, and the lighting equipment of a large number of small towns on the other. Extensive territory occupied by large buildings and well lighted grounds calls for a well developed lighting plant. A plant of this character is simply an illustration of the natural growth of a private plant to fill the needs imposed upon it. It becomes large, complex and expensive, but retains in every respect the fundamental elements which originally constituted it. A private plant thus becomes private only because its lighting is done for a relatively limited community. It need not be a small community, but its lighting must be of such a character that the machinery and devices required bring it into the classification of central stations. This brings forward the point of interest—the fact, that the scope of the lighting done by a central station makes it such—it is the lighting which makes the station, not the station the lighting. This distinguishing feature clearly shows that large plants or central stations are rarely if ever erected unless either contracts for current have been closed or subscriptions to that effect are in the possession of the promoters of the enterprise. The outlay for boilers, engines and generators is an expense which does not demand a very heavy premium for their continued support and operation. In other words, the largest of generators and engines do not require a better man than those of half the size. In fact, it is surprising to realize how few hands are necessary to attend to the running of the largest of central stations. A private plant represents no departure in this respect.

The cost of its operation is proportionately higher as compared with its output than that of a central station. Increase its size, however, and it rapidly merges into the latter type. These considerations throw some light on the question of expense of operation and the legitimate charge for current in the case of electric light companies. The greatest outlay of such concerns is not the station or the real estate, but the underground equipment. If the wires are strung overhead, the expense still stands. All the wit and ingenuity of experts is tried to its utmost in the effort to limit the cost of the wasted power in the circuits and still not invite unusual expense in the design of these circuits. The financial load of central stations, with a vast network of copper mains and feeders demanding an annual interest payment, and a large bill for wasted energy in these conductors, is bound to be very great even with a large circle of customers. The law enunciated by Lord Kelvin, "That the interest on the cost of the copper conductors should not exceed the cost of the power wasted in them," was a guide in the early days, when simple systems were in vogue. It is only a hint of the expense sustained to-day. But with all that, the large private plant is not a loss to its operators, if intelligence is displayed in its equipment, and the care it requires. Private plants and the cost of their lighting have been compared with the cost of an equal amount of lighting by central station on numerous occasions. The result has not always been satisfactory to either. Many large establishments have taken out their systems and depend entirely upon the street service. To negative this, evidence can be produced to show that many have installed private plants to avoid this necessity and in some cases only to become independent of what they call "the lighting monopoly." As far as this latter is concerned, it is quite evident that the destruction of competition in the lighting field gave rise to it. It has borne its own evils, and they in return react with all the bitterness and contempt of an aroused public opinion. It is to be admitted that electric lighting is an expense, but why an unusual one is beyond comprehension.

From a general standpoint, it seems that the enormous increase in business which lower rates would induce, is in itself a guarantee of the shortsightedness of any other policy. Yet, while the haberdasher, the dairyman or the baker, may make undisturbed whatever profit they see fit to demand, it hardly seems fair because a franchise has concentrated public attention upon what is regarded as a public necessity, that the one can go its way in peace and the other be haled to the bar of justice. Large business interests may not be so hurried in their cooperation and consolidation in the future. The public can cope easier with the giant than with any of his limbs. The lighting corporation represents a totality of interests, that can best continue on a useful and profitable career by agreeing to the popular demand. By this means the increasing application of electrical energy would mean a widespread benefaction to the poor as well as to the prosperous.

* * *

The Result of Chicago's Election.

As expected, Judge Edward F. Dunne defeated John Maynard Harlan for Mayor of Chicago in the recent election. The question at issue was municipal ownership, but holders of traction stocks are not alarmed over the result. These are the steps by which Mayor Dunne—who assumed the duties of his office on Monday—expects to bring about what he was elected for:

"By the appointment of a commission of street railway experts and eminent lawyers, placing at their head a big man worth a big salary—a $50,000 man in merit, if not in price—and raising the money to pay him by public subscription, if need be. By requiring this commission to consider the situation, the value and utility of all present street car properties and to arrive at a conclusion for general action, no radical move to be taken prior to the decision of this body. By making, while these larger plans are in process of evolution, a direct experiment with the line upon which the franchise already has expired, securing the right to operate by moving Judge Grosscup to release the line from the injunction proceedings which now tie it up. By prosecuting what court actions his corporation counsel and other advisers decide will fit into the grand scheme."

From a survey of the new city council membership as regards probable action on municipal ownership of street railroads, friends of the corporations assert that they are not fearful of the results of any legislation that may come before the councilmanic body. In fact, it is asserted, in some quarters, the council will be a safe neutralizing agent, as practically the same men who were in control of the last council will retain control of the next one.

As the Illinois Legislature will soon adjourn for two years, during the term of Judge Dunne as Mayor no State legislation can be enacted to enable Chicago to increase its public debt, for the purpose of purchasing the street railroads of Chicago, or for any other purpose.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

It is reported that the daily output in Germany of the tantalum lamp, which will shortly reach an average of about 5,000 a day, is sold as fast as produced.

The Magnetic Club of New York will hold its spring meeting and dinner at the Hotel Astor Thursday, April 13.

It is announced that the Legislative light inquiry in New York will be finished this week and that the committee will present bills for enactment reducing materially the legal limit of charges for gas and electricity.

Mr. Frank W. Frueauff of Denver, when in New York last week, stated that the railroad people had been making an extensive canvass among possible delegates for the Denver-Colorado Springs convention of the National Electric Light Association. They report their belief that there will be an attendance of at least 3,500. This may be a little optimistic, but there is no question that the meeting will break all previous records in point of attendance as well as in point of general attractiveness.

The "Journal" of the Chemical Society contains an abstract of an article by Mr. R. Ditmar on the action of radium rays on caoutchouc. The power of radium rays of penetrating caoutchouc has been examined by Madame Curie's radiographic method. A "concentrated" preparation of de Haen's radium barium bromide was used, but the action of this substance was not sufficiently powerful to induce radioactivity in the caoutchouc itself. The following conclusions, says the "Electrical Engineer," London, have been derived from the results of the experiments of the author and the investigations of Madame Curie. The radium rays penetrate both crude and vulcanized rubber, but the former more readily than the latter, probably owing to its porosity. Caoutchouc itself may be rendered radioactive (Madame Curie). The loss of activity of caoutchouc in air does not take place in accordance with the law which usually obtains for solids.

The New York Electrical Show managers are taking time by the forelock and announce that the exhibition will be held at Madison Square Garden December 12 and 13. Prof. G. F. Sever is director of exhibits.

Wireless telegraph experiments with trains will be tried at Purdue University in Lafayette, Ind. The electrical engineering building commands a view of long stretches of the Monon, Wabash, Big Four and other railroads, and instruments will be placed on various trains for testing purposes. It is believed by Prof. Kelsey of Purdue that difficulties encountered in previous tests have been overcome. It is the intention of the university to conduct a series of tests to the end that a receiver may be placed in the cab of the engine, within reach of the engineer, from which he may take his running orders from the dispatcher without stopping his train.

Mr. LaRue Vredenburgh, who so ably handled the subject of advertising in his report presented at the Boston convention of the National Electric Light Association, will this year make a report on "The Commercial Side of Sign and Decorative Lighting," which will be presented at the Denver-Colorado Springs convention. This is a subject of great interest to all the members of the association, and Mr. Vredenburgh's skill and experience will enable him to handle it in a most satisfactory and interesting manner.

A meeting of the National Conference on Standard Electrical Rules will be held at 10 A.M., Friday, April 21, at 55 Kilby street, Boston. The American Institute of Electrical Engineers will send an official delegate and will also be represented at the sessions of the Conference by its Committee on National Electrical Code.

HIGH POTENTIAL APPARATUS FOR WIRELESS TELEGRAPHY.

BY A. FREDERICK COLLINS.

The development of the alternating current transformer has been due to the extension of the single-phase current, but the induction coil owes its present state of perfection to the discovery of the X-rays and the advent of wireless telegraphy.

While both the induction coil and transformer utilize the same principles of mutual induction the fine distinction between them lies in the fact that the former is energized by a direct current from a suitable source of electromotive force and converts this into an alternating current by means of an automatic make-and-break, while the latter transforms an alternating current into one of higher or lower potential, as the case may be.

At the present writing both of these devices are employed extensively in wireless telegraph practice, but there are several other arrangements by which the high potentials necessary for producing a disruptive discharge of sufficient intensity to set up oscillatory currents may be obtained. For instance, we may cite the frictional and static induction machine, the Elihu Thomson condenser apparatus, and recently James Foster King has proposed an ingenious method for raising the pressure of a direct current by self-induction until a sparking potential results.

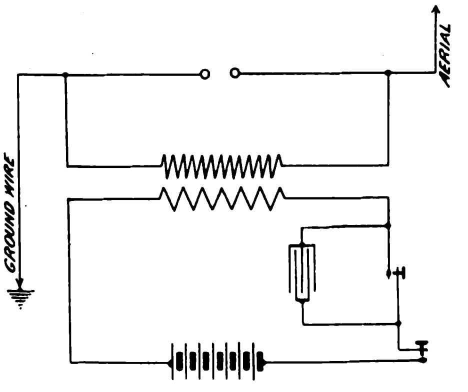


Fig. 1.
Induction Coil Transmitter.

In wireless telegraphy it is of prime importance to have a large current strength as well as a high tension, in fact the working pressure is usually little more than that of long distance transmission lines, say from 20,000 to 50,000 volts. In the glass-plate machine these conditions do not prevail, for the pressures are enormously high and the current values infinitely small, hence this type of apparatus has found little application in experimental wireless transmission and none at all in commercial work.

The induction coil with its record of over half a century as a producer of electric sparks was the first of the devices used for the purpose under consideration. It consists essentially of a long, straight soft iron core, a primary winding called an inductor, the terminals of which are connected with a battery or other generator, and an automatic interrupter; shunted around this make-and-break device is a condenser, and the whole schematic arrangement is indicated in Fig. 1. Outside the inductor is wound the secondary coil, the terminals ending in brass spheres which form the electrodes of the spark-gap.

The inductor of a primary coil is most efficient when it is formed of two layers, and the wire should be of large cross-section so that the losses due to heating may be reduced to a minimum, but if too large the inductance will tend to produce excessive sparking at the interrupter contacts. To overcome this objectionable feature a number of small wires, equal in conductivity to a single large one, may be used to advantage.

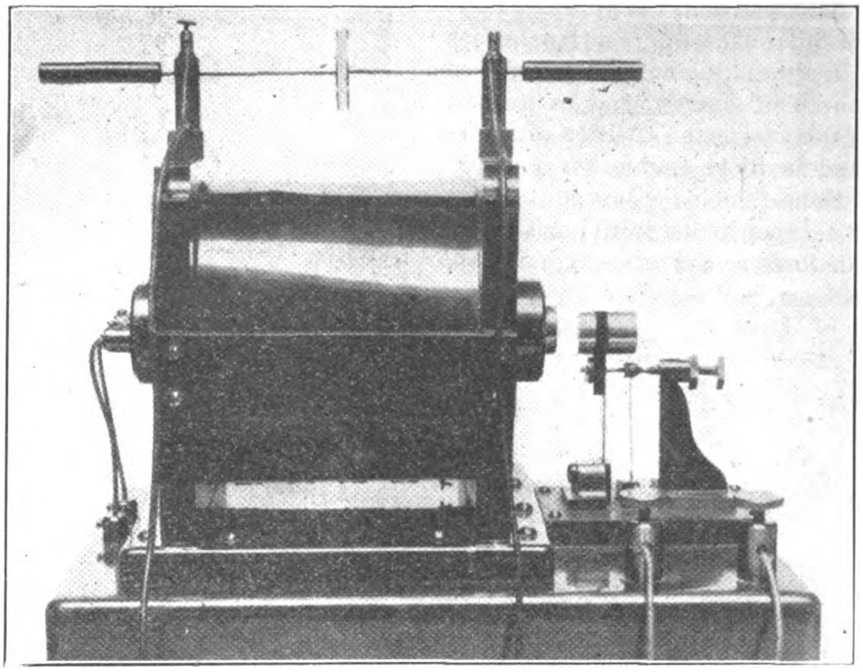


Fig. 2.—Induction Coil.

The wire used in winding the secondary for a wireless telegraph coil should be at least 50 per cent. greater in cross-sectional area than that intended for X-ray and general laboratory work, thick and short rather than attenuated, and long discharges are required. Now, as the ratio of transformation is directly proportional to the number of turns of wire forming the secondary and primary, the output at the terminals of the latter will be equal to that of the initial energy except for a small loss in transformation and a large waste that takes place on the breaking of the circuit by the interrupter.

The insulation of induction coils is of great importance, for unless great care is exercised in this detail of construction electrostatic stresses are set up between the successive disks making up the secondary, and these have a tendency to strain the insulation, especially if air bubbles have been formed, in which case the coil may be disrupted at any time. In building large coils it is the practice of makers to pass the silk or cotton-covered wire through a compound of melted resin and beeswax in winding the disks, and then after these are connected together they are placed in vessel of the same ingredients while in a fluid state and under the receiver of an air pump the air is thoroughly exhausted, and in this way a vacuum secondary is formed.

The vibrating make-and-break is the most familiar type of interrupter used, but the mercury turbine and electrolytic interrupters are much used in connection with coils designed for wireless transmission, and especially is this true of those of foreign construction. The break should be as nearly instantaneous as possible, and the more nearly this ideal is approximated the smaller may be the capacity used.

The function of the condenser, which is shunted around the interrupter, is to prevent excessive sparking at the contacts when the circuit is broken. With electrolytic interrupters no condenser is required, for the breaks take place at the rate of 10,000 per minute, and this gives the inductance of the primary current but little time to rise to a potential where it is accentuated, and further, an electrolytic interrupter possesses a certain inherent capacity of its own which entirely eliminates any untoward effect that might otherwise result.

The chief advantage the alternating current transformer has over an induction coil for the conversion of low voltage currents into effective disruptive discharges for the production of electric waves is that the uncertainties of the interrupter are entirely done away with, while in large units it becomes possible to take care of a greater amount of energy than where the cycle of operation requires an absolute break. Again, a transformer may be constructed with mathematical precision, which is practically impossible with an induction coil.

On the other hand, where a transformer is used an alternating current is required as a source of energy, and in isolated stations this means the addition of a generator and finally an engine for its operation. Hence the induction coil system is much cheaper in its initial cost than the transformer and its auxiliary appliances.

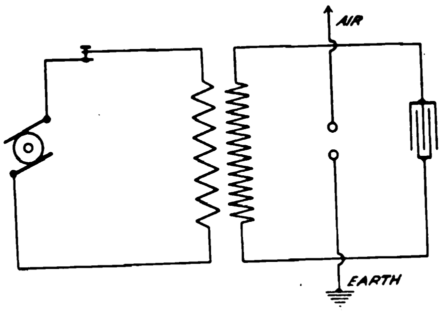


FIG. 3.
Transformer Transmitter.

In the alternating current transformer the generator is connected in series with the primary of a transformer; the terminals of the secondary are connected in series with a number of Leyden jars, and a spark-gap is usually shunted across the terminals, as shown in Fig. 3. When the jars are charged to their maximum capacity they break down the insulating film of air forming the spark-gap and a disruptive discharge of great intensity takes place. This is the type of oscillating current generators that have been installed by Marconi at the Poldhu, Glace Bay and South Wellfleet transatlantic cableless stations.

While the construction of transformers are more or less well known a few words concerning their manufacture for wireless telegraph purposes may be of some value. The transformer usually employed is known as the core-type, that is, a core made of sheet iron stampings in the form of a rectangle frame, and forming a complete magnetic circuit takes the place of the straight iron core in the ordinary type of induction coil. Over the limbs of the core the primary and secondary coils are slipped into position. The primaries of each coil may be connected in series or in parallel in order to obtain the proper value of voltage in the primaries; the secondaries are usually connected in parallel, the terminals leading to the electrodes of the spark-gap. Coils of this construction are placed in either iron or wooden cases and these may be filled with oil or insulated with solid asphalt.

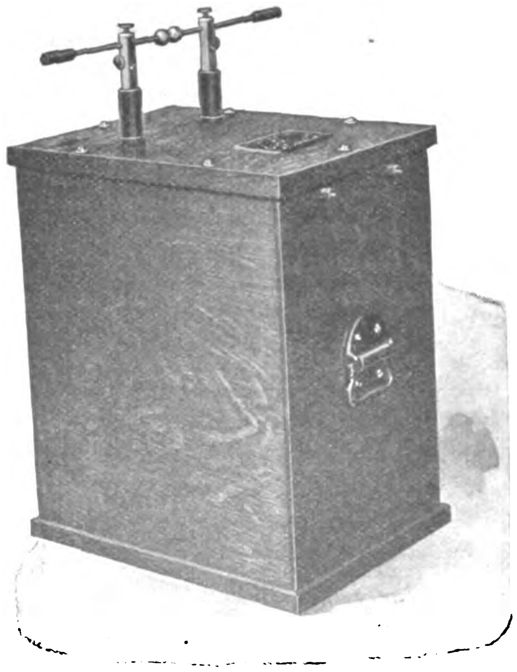


FIG. 4.
High Potential Transformer.

A recent device designed by Prof. Elihu Thomson for producing heavy disruptive discharges is shown in Fig. 5. It comprises a small rotary converter which is operated by a direct current, and through slip-rings and taps single phase currents may be taken off. This portion of the apparatus is contained in the lower part of the wooden case, the latter also including a transformer for stepping up the low voltage current to one of 20,000 volts.

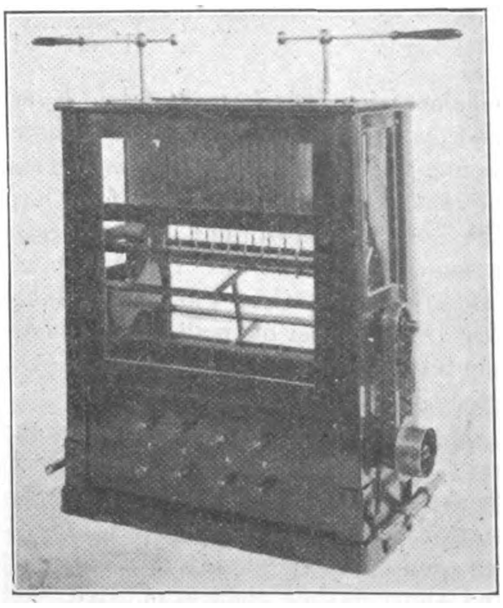


FIG. 5.
Prof. Elihu Thomson's High Potential Generator.

The latter are connected to two arc-shaped pieces which are insulated from each other and do not form contact with, but come very closely to, projections on the revolving frame below. On one side of these arc-shaped pieces are a similar set arranged in two series, corresponding to the two terminal pieces and leading from them to a set of glass condensers. When the high potential terminals make connection through the revolving frame with the condensers they are charged in parallel, as though they formed one large condenser, but when the frame is partially revolved again they are connected in series, so that their individual potentials are added together, and in this position they discharge through the spark-gap, when, assuming that there are ten condensers, the effective potential would now be 200,000 volts.

This apparatus is a very effective high potential generator, and as it is portable is not affected by the weather and its potential may be easily regulated; it should prove of great value as a converter of low voltage currents into high oscillations, such as are required for long distance wireless telegraph transmission.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

THE TELEPHONE.

The Transmission of Speech.—To transmit speech by electricity is one of the most interesting exhibitions of the law of the conservation of energy. To speak is to produce a series of vibrations in the vocal chords, the effect of which is to create air waves or sound waves. The exact nature of this process in a human being belongs to the department of physiology, but the influence and effect of these sound waves upon the telephone, the means by which they are transmitted and again distributed falls distinctly within the province of electricity.

The act of telephoning therefore consists of three processes, each of which contributes to the general result in a manner exhibiting an indispensable relationship. They are as follows:

First—Sending or directing the voice into a transmitter.

Second—Conducting the voice equivalent over a line.

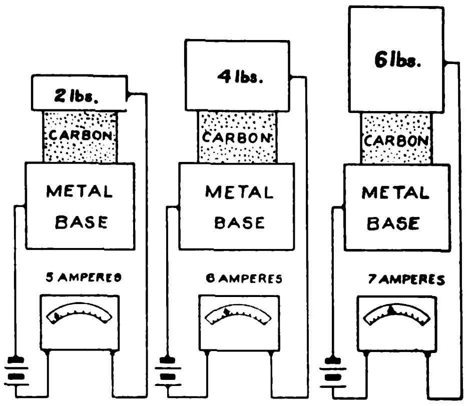
Third—Receiving the voice equivalent at the end of the line.

These elementary processes necessarily call for devices suitable for the purpose in view and, in consequence, the process itself has been the means, in each individual case, of giving a name to the apparatus.

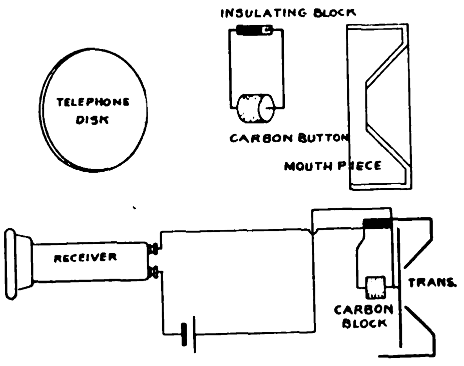
The sending instrument is called the transmitter, the conducting circuit the line, the instrument which conveys the sound to the ear the receiver. It must not be understood from this that any *sound* is either transmitted, conducted or received. The phenomena are all electrical and magnetic in the strictest and fullest sense of the word, with two exceptions; these are the instances where the human voice enters the transmitting device and where, when *its electrical equivalent* operates upon the receiver, it is transformed into the more or less familiar tones of ordinary speech.

Historical.—The invention of the telephone is generally credited to Dr. Alexander Graham Bell, and justly so from a broad legal and scientific standpoint. Other workers in the same field were Dr. Elisha Gray and Reis, but their efforts were not of a sufficiently practical nature to entitle them to the credit of the present device, which is not the transmitter but the telephone receiver. Although transmitting and receiving instruments in practice are entirely different in their principle and construction, one being purely electrical and the other purely electro-magnetic, yet both the transmitting and receiving of speech was successful over short distances with but one instrument, the receiver, on which was based one of the most successful and indispensable electrical systems ever evolved for general use.

The Telephone Transmitter.—The nature of the device used for transmitting speech is based upon the requirements of an acoustic electric system. The general idea underlying all the operations is that of receiving the air vibrations, reproducing them as far as possible in the form of electricity, sending them over the wire as a set of electric undulations and finally turning the electric undulations into sound waves by means of the telephone receiver. The theory upon which the transmitter operates is that of the effect of mechanical pressure upon a small block of carbon. The mechanical pressure is obtained by means of a thin sheet of iron called a diaphragm, which is so mounted as to delicately and irregularly compress a carbon button at its center. The diaphragm is of the thickness of ferrotype iron (photographic iron) and when the human voice is so concentrated by means of an appropriate mouthpiece to play upon it, the air vibrations or air waves beat upon the diaphragm with varying degrees of pressure which, being conveyed to the carbon button, compress it with great rapidity to an infinitesimal degree each instant. If a current of electricity is allowed to flow through the carbon button, which under ordinary conditions is uniform in strength, it is evident that when the carbon button is being thus affected, by the varying degrees of pressure, the current will also be affected if it can be shown that *the conducting power of the carbon* is continually changing. This is the case in point; the resistance or the carbon changes with each variation in the mechanical pressure caused by the voice waves. These changes are the cause of corresponding waves or undulations in the current, and their detection is best accomplished by means of the receiver. In other words, the transmitter is a device in which the human voice causes a carbon button to increase and decrease in resistance, and a uniform current passing through this button at the time will have its strength increased to an infinitesimal extent when the diaphragm presses against it due to the impact of an air wave. A current is therefore always passing through the transmitter when it is in use; and its delicacy and faithfulness in reproducing the air waves impinging upon it, in the form of electrical undulations, depends upon the adjustment between the diaphragm and carbon button.

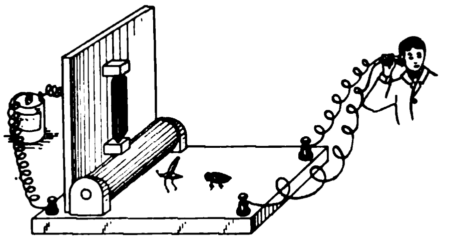


Effects of Mechanical Pressure on Carbon in Reducing its Resistance.



Elements of a Transmitter.

The Microphone and Carbon Button Transmitter.—The introduction of the carbon transmitter by Emile Berliner, Blake and Edison was the means of relegating the original Bell telephone to the function of a receiver. It is in this respect, which is as a detector of minute variations in current, that the receiver best serves its function. Long distance telephoning would be impossible without the transmitter, which in its present form is only an adaptation of the original microphone of Hughes. The idea he had in mind was to invent a phonendoscope, by means of which the respiratory organs could be tested The extreme delicacy of the microphone and the need of preserving the original sounds of breathing and of the heart beats caused his suggestion and device to fail in this respect, although otherwise recognized as a most remarkable invention. A microphone is in reality a "sound microscope." It will develop or augment delicate sounds to such an extent that in a well constructed device of this character the walk of a fly, the human breath or the merest scratch are magnified to enormous proportions. The device consists of a sounding board on which is mounted two carbons in delicate adjustment with respect to each other and in circuit with a battery and telephone receiver. Depending upon the adjustment, as previously stated, the carbons will, under the influence of the faintest vibrations, cause minute changes in current strength, due to varying degrees of pressure of one carbon upon another, and thus develop sound in the receiver. The carbons are therefore governed as far as their operation is concerned by



A Microphone in Service with a Receiver.

First—The adjustment in a mechanical sense.

Second—The fineness of quality of the carbon.

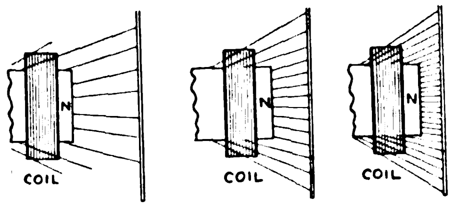
Third—Uniformity of the current.

Transmitters for telephonic purposes are made with reference to the service they are to perform; to transmit the voice with all of its characteristics, as far as science will allow. They are made in two forms, either with a hard carbon button, or in particular cases where extreme delicacy is required, with a tube of granular or powdered carbon with a plug of carbon at each end. It is but reasonable to infer from the preceding that great delicacy of action can only be obtained through the medium of the carbon, and it therefore follows that the texture of the carbon, either as a granulated mass or in the solid form, must receive the closest of attention in the construction of transmitters for local and long distance service.

Fundamental Tones and Overtones.—That which is called timbre is the characteristic of any musical sound. It is the distinguishing feature between the same note of a piano and a violin. The investigations of Helmholtz clearly proved that this characteristic difference was due to the presence of overtones. By this is meant that when a string is set into vibration, it not only produces a sound at the expected rate of a certain number of waves per second, but in addition a host of smaller secondary waves which enrich the tone and establish its character. The human voice is no exception to this, as its fundamental tones are aided by a series of overtones, the variety and quality of which must be preserved in telephonic transmission as far as possible, if the identity of the owner is to be readily recognized. The fundamental tones are more easily transmitted than the overtones, due to the effect of inductive influences in the line; but retardation occurs with respect to the others, depreciating the transmission to a serious extent. The transmitter must pass these tones, transformed into alternating current waves in the line and receiver as completely as the device will permit. Adjustment thus becomes a fine art, and is conducted with reference to the average clearness and loudness obtainable. This is exemplified in the case of a man and a woman's voice reaching over the line with almost equal distinctness, which is a matter of little or no comment in local lines, though a matter of great surprise in thousand mile circuits.

The Receiver.—The receiver was first exhibited publicly at the Centennial Exposition at Philadelphia in 1876 by Dr. Bell. This instrument, with which speech can be both transmitted and received acts as a transmitter entirely by electro-magnetic induction. The principle of its operation is identical with that which serves to underlie the construction of all generators of electricity. In other words, the receiver is essentially a dynamo, generating minute alternating currents, which serve to excite corresponding vibrations in another receiver. The fundamental idea predominating in the case of a receiver is that of the variation in the number of magnetic lines of force passing through the coil of the receiver. That which is so called consists of three parts as follows:

The magnetized steel bar.
The coil of fine wire.
The diaphragm of iron.

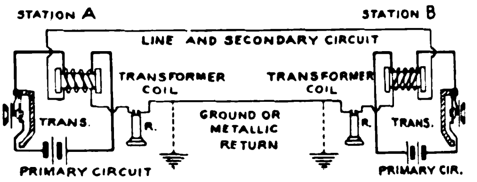


Distribution of the lines of force at the end of a telephone receiver when the diaphragm is far away, nearer and at a normal distance. More lines pass through the coil in each case.

The magnetized steel bar is fitted with a small coil of fine wire at the end nearest to the diaphragm. This coil of wire is placed on the end of the magnet, and is made of many turns, so as to be sensitive to the slightest change in the number of lines of force entering it. The elements of a dynamo thus appear: the source of magnetic energy, the coil or inductors affected by the magnetism, and the energy generally throwing these elements into co-operation. In this case, the mechanical energy of the voice is absorbed in setting the disk of iron into vibration. In this particular respect, the vibration of the diaphragm and its relation to the magnetic field radiated from the magnetic poles is entirely a matter of leakage. By this is meant, that in general the fact of moving a piece of soft iron in the vicinity of a magnetized body, is to disturb the arrangement of the lines of force of that body. Those that have been radiating freely into the air will now, to some extent, pass into the mass of iron in their neighborhood. The near presence of a thin plate of soft iron at the end of a permanent magnet means a certain arrangement and position of the lines of force at that end. The least movement of the iron and the lines of force will slightly change position. In other words, the nearer the iron is moved to the end of the magnet, the thicker they will cluster around the iron, and in doing so the greater the number that will now thread the coil. The vibration of the diaphragm is thus the means of moving an iron mass nearer and further away from a magnetized body. In this manner the lines of force entering the coil are constantly varying in number, with the result that exceedingly delicate alternating currents are produced as the equivalent of the extent of the variation in the lines of force in the coil, or primarily as the result of the impact of air waves caused by the human voice. Currents like these, received in a similar instrument will, when they pass, move the iron diaphragm back and forth with each complete alternation. The effect of this is a duplication of the sounds of speech.

The transformation is, therefore, exactly the same as that transpiring in an electric power transmission plant. First, the absorption of mechanical energy and its transformation into electricity; second, its conduction to another point, and finally its retransformation into mechanical energy again.

A Simple Station System.—To raise the pressure of the current issuing from the transmitter, use is made of a coil of two windings. This miniature transformer receives the current of the battery, which passes through the carbon contacts of the transmitter, in its heavier winding or primary coil. The coil of fine wire forms another circuit, distinct from the first, in conjunction with the outside line and the two receivers. In the illustration one-half of the line is shown as either metallic or grounded, This is accomplished by means of gas pipes or a sunken metal plate at each end. The battery circuits are purely local at each end, operating with entire independence. The battery must receive attention if its strength diminishes, though this has been replaced in city equipments, particularly New York, by an independent current line, the power being generated in small dynamos and distributed for the same purpose.



Simple Two-Station Telephone System.

The points of contiguity between the three circuits are only two, and occur at either end where the transforming coil is found. Thus the system in its simplest form consists of the following:

First—The primary circuit at one station.

Second—The secondary circuit including the line.

Third—The primary circuit at the second station.

The transforming coil is actuated entirely by electro-magnetic induction as well as the receivers; the system therefore appears as one in which the transmitting devices operate through slight variations in the resistance of carbon buttons and the transformation, conductance and receiving through slight variations in magnetic fields.

The Peruvian Corporation is planning to build an electric railway to connect the city of La Paz, Bolivia, S. A., with the Peruvian Railway, which has its terminus at Lake Titicaca.

THE FUTURE OF THE ELECTRIC AUTOMOBILE.*

BY T. G. CHAMBERS.

In dealing with the future of the electric automobile it is impossible to foresee what developments may take place. The discovery of some new accumulator of small weight and of great capacity, with phenomenal endurance would, of course, alter existing conditions; but it is far more probable that nothing of the kind will be found, and that we shall continue to use the same materials that we have today with all their drawbacks. I propose to consider the commercial future of the electric carriage in its present form. Here we have certain reliable data upon which to base conclusions. We are aware of the requirements in certain directions, and we know the economical and practical advantages, as well as the limitations, of the electric carriage. The elasticity of the electric motor and its ease of control, together with silence and absence of smell and vibration, made the electric carriage very attractive at an early date. The inherent disavantages of the dead load of accumulators and the necessary limit to the available supply of energy which could be carried, were not so apparent in the days when automobiles of all descriptions were of comparatively slow speed, and when a day's journey of 100 miles without a hitch was a rare occurrence. Experiments with carriages propelled by the power available from primary cells carried in the vehicle date from 1832, but it was not until the year 1881 that a carriage was designed to carry secondary batteries. The modern electric car has been developed during the 24 years that have elapsed since that date.

The electric carriage is as nearly proof against mishap as any machine can be. Taking the last six months' working of the Electromobile Company's Curzon street garage, I find the total involuntary stops, excepting those due to power exhaustion, to have been 61 in 159,258 carriage-miles. Of these stops 14 were due to a mechanical defect in the contact breaker, the possibility of which has since been entirely eliminated by an improved mechanism; nine were due to tire troubles; 13 were due to the blowing of the main fuse, a matter immediately repairable by the driver. This leaves only about 25 stops in about 160,000 carriage-miles necessitating the attention of a mechanic, or on an average one stop in every 6,400 miles. When it is remembered that at least half these carriages are in the hands of comparatively raw drivers, and practically all of them are in the hands of men without mechanical training, the reliability may be considered very great indeed.

When the limitations of the accumulators are understood and recognized little or no difficulty arises from power exhaustion. With an effective range of from 25 to 35 miles upon one charge, and with the adoption of interchangeable batteries, a carriage may be run all day, if only time be allowed for its return to a depot to take up a new battery, an operation which takes from two to three minutes. The far-reaching importance of this system of rapidly exchanging an exhausted battery for a fully-charged one cannot be too much insisted upon. It will probably have a material effect upon the future of the electric carriage.

Even with a garage in the most expensive and central position of London the total costs per year are considerably less than they would be in the case of a horse-drawn carriage giving a similar degree of luxury. When the electric carriage is used to its full extent the costs are very considerably less. In certain individual cases I might name, owners have effected an economy of as much as from $1,000 to $1,500 a year by exchanging their horse carriages for electric vehicles, and in no case am I aware that they are spending more than they did with their horses. As compared with other types of automobile, I am of opinion that on the absolute bedrock of cost per carriage-mile under similar conditions the electromobile will show an advantage.

Accumulator renewals have been reduced by organization and careful treatment to a figure equal to, if not below, that of the cost of tire renewals, and in other respects the mileage costs of the electromobile will compare favorably.

With regard to future cost one may confidently predict that the tendency will be downwards as regards both power and battery renewals. At the present time the most favorable contracts that can be obtained in London for power supply do not bring the cost per Board of Trade unit below 3 cents. There is no reason why this should not be reduced to 1 cent. The cost of renewals of battery plates will be very largely reduced as the output of plates is increased by the demands of the growing business. This will be more marked if an agreement as to the use of a standard plate can be come to by the principal makers of electric vehicles.

We may now turn to the main object of this paper, the consideration of the commercial future of the electric carriage. Dealing first with the touring car, I will at once suggest that the electric carriage will not be the touring car of the future. Nothing short of the discovery of some new element will provide us with a battery that will give us the electric touring car. The lead accumulator will not give it to us, even if improved 50 per cent. and if the country be studded with charging stations. I do not think the nickel battery will give it to us, whatever may be its possible practical and commercial advantages in other directions. The electric car with a featherweight battery would still have certain disadvantages as compared with the explosion-engine carriage. The charging station would have to be reached, and there would remain the risk of battery exhaustion through accidental increase of power consumption on account of bad roads, hilly country, faulty lubrication, and a hundred other causes.

Turning to commercial vehicles, the question of the required range of action is the dominant factor. Given a limited distance and suitable roads, I see no reason why the electric carriage should not have a very considerable future in this field, nor why the light delivery van for town use should not be accumulator driven. Here the conditions are very suitable. Ability to start at once, noiselessness, reliability in the hands of an unskilled driver, the small amount of overhauling required, and the moderate amortization fund necessary for renewals, are all arguments in favor of the electric carriage. The light electric delivery van is already a success in other countries. With regard to price, the time is not far distant when such a van can be sold at a very moderate price, say from $1,500 to $1,750, without tires or batteries, and the tendency will probably be towards the sale of such carriages outright to users, the sale being coupled with a contract for maintenance together with the use of tires and batteries upon loan; such a system will appeal to the user, as the capital outlay will be small, and he will have the security of the maintenance contract against unknown expenditure on upkeep.

The omnibus of the future will not, in my opinion, be electrically driven. The conditions are by no means those in which the accumulator car is likely to be successful. The constant and erratic stopping and starting, often upon hills, and the heavy weight of body and passengers, are quite against it. If the accumulator passenger tramcar running upon rails has been unsuccessful in the past, it is only reasonable to conclude, having regard to the expense of tires and the increased consumption of energy, that it will be even less successful on the common roads.

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*Abstract of paper presented at a meeting of the Automobile Club, London, Eng., March 16, 1905.

The hackney cab constitutes another very difficult problem, and I think it will still be a long time before any self-propelled carriage will be commercially successful in this field. Any discussion on this subject is bound to center itself on the question of costs, and I do not believe that sufficient experience has been gained in the practical operation of automobile cabs for a sound opinion to be forthcoming. Town ambulance work is so essentially the province of the electric car that I may be forgiven the mention of such a limited field. In this case every advantage of the electric carriage plays an important part, while its disadvantages have little or no effect. The only necessity is a proper organization to deal with the carriages, and this may already be said to exist in its best form in connection with the fire brigades, which have reached such a high pitch of excellence in most of our cities. There would be no difficulty in rendering every fireman and every police constable an efficient driver.

It is unnecessary to say much with regard to the automobile of the future which is to take the place of the smart horse-drawn carriage. In my opinion this will, without doubt, remain electrically driven. It is probable that in cases where only one carriage can be afforded, the petroleum car will always be in demand; but when two automobiles can be kept, it is more than probable that the electric carriage will be universally adopted for purely town use. The petroleum car is not likely to become the carriage for shopping, calling, theater or night use.

There remains to be considered one very important field of the future. What automobile is to take the place of the single-horse brougham? The average medical man cannot afford to pay more than $1,250 or $1,500 a year for the use of a carriage, including the driver. I do not think that any automobile which the smart doctor leaves standing outside the doors of his fashionable patients could be let out to him at less than $1,625 a year. Is this a prohibitive figure, considering the advantages which a business man would receive by the increased speed of his carriage, and, as a consequence, the larger amount of time he could give to his professional work?

* * *

Dr. Lee De Forest, inventor and at the head of the American De Forest Wireless Telegraph Company, is in Havana, Cuba, installing stations.

PROVIDING FOR INCREASE OF POWER IN ISOLATED STATIONS.

ARTICLE IV.

BY W. H. WAKEMAN.

Calculations to demonstrate the increase in power secured by plans given in the preceding article will prove interesting to engineers. As we assume that an economical load is to be carried in both cases, the terminal pressure will be about 5 pounds above atmospheric pressure, which is assumed to be 15 pounds. This makes the terminal pressure about 20 pounds more or less according to conditions. Clearance will not be included in these approximate calculations.

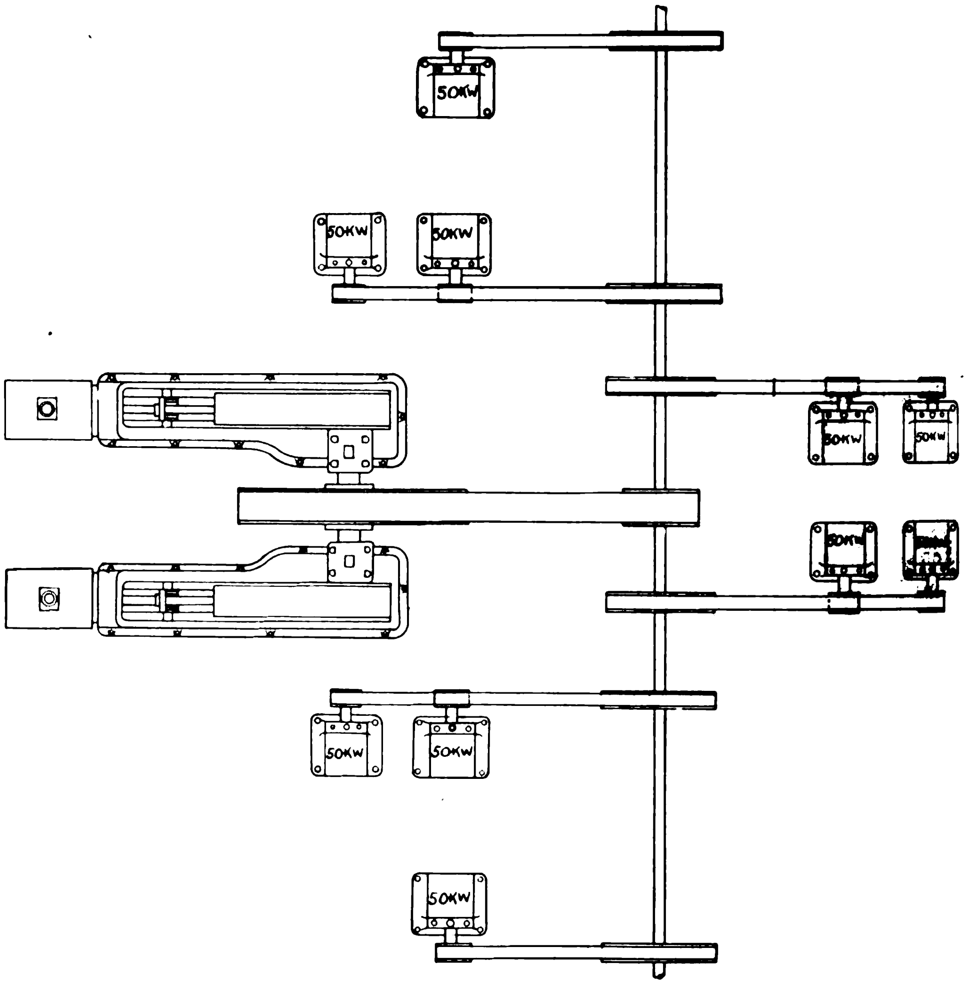

Fig. 5.

With a gauge pressure of 75 pounds the initial pressure should be 70 under fair conditions, or 85 pounds absolute. As the ratio of expansion is found by dividing the initial by the terminal pressure, in this case it is 85 ÷ 20 = 4.25. As we now have the initial pressure and the rate of expansion the mean effective pressure may be found by the following formula:

$$\frac{H + 1 \times P}{R} - B = M.E.P.$$

H = hyperbolic logarithm of ratio of expansion.
P = initial pressure absolute.
R = ratio of expansion.
B = back pressure absolute.
M.E.P. = mean effective pressure.

Assuming that there is no back pressure above the atmosphere, and applying the formula to the conditions mentioned, results as follows:

$$\frac{1.4469 + 1 \times 85}{4.25} - 15 = 33.94 \text{ pounds}$$

mean effective pressure.

The area of a 20 inch piston is 314 square inches, and at 70 revolutions the piston speed is 490 feet. The result is that

$$\frac{314 \times 33.94 \times 490}{33{,}000} = 158 \text{ hp. developed.}$$

Raising the boiler pressure to 110 pounds by the gauge gives 125 pounds absolute, and allowing for friction in pipes and ports gives 120 pounds initial pressure. As we wish to have about 5 pounds terminal pressure by the gauge, or 20 pounds absolute as before, the initial is divided by the terminal pressure, showing that the ratio of expansion must be 120 ÷ 20 = 6, the hyperbolic logarithm of which is 1.7918. Applying the formula already given for finding the mean effective pressure the result is:

$$\frac{1.7918 + 1 \times 120}{6} - 15 = 40.83 \text{ pounds.}$$

Changing the speed from 70 to 90 revolutions raises the piston speed to 630 feet and the power developed under the conditions is

$$\frac{314 \times 40.83 \times 630}{33,000} = 244 \text{ hp.,}$$

showing a gain of $244 - 158 = 86$ hp.

Another plan for providing more power when it is wanted is to put a crank on the other end of crank shaft of a single engine, then when the proper time comes the outside pillow block may be removed and a frame put in its place. This makes it possible to add another cylinder whenever wanted, thus doubling the power of engine. This is shown in Fig. 5. It gives $244 \times 2 = 488$ hp.

It is necessary to make calculations for a heavy increase of power when the station is first laid out, and design the crank shaft, flywheel, belt, main pulley and line shaft so that they will carry the greater load when wanted, as otherwise one or more of these parts will fail and cause trouble.

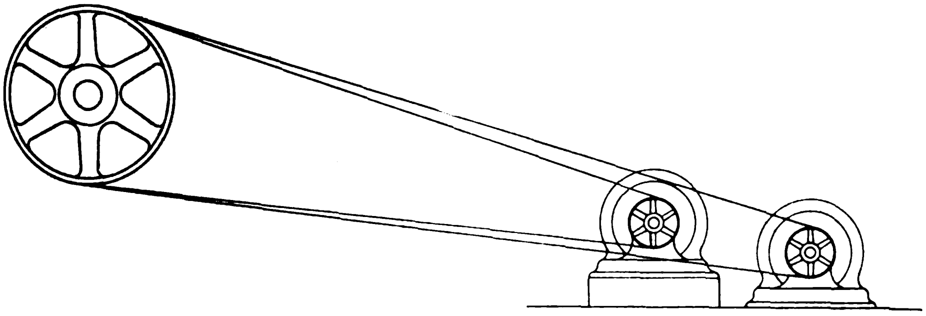

Fig. 6.

It will be noted in Fig. 5 that there are two dynamos in line. An elevation of this arrangement of belts and machinery is shown in Fig. 6. One belt is placed around the other, so that one driving pulley is used for two dynamos. Of course this makes it necessary to run both dynamos at all times when one is wanted, unless one belt is taken off, and that is not recommended, as it takes too long to do it, especially if the inner one is disabled. The writer has seen three belts run on one pulley in this way driving three dynamos.

Every pulley on the line shaft, as here shown, should be a clutch pulley, so that the dynamos it drives can be stopped at any time without interfering with others. To some engineers this caution may seem superfluous, but so long as cases can be found where clutch pulleys ought to have been used, but were not because they cost more than the plain kind, there is evidently chance for improvement. When we consider that electric stations and power plants are sometimes designed and built by men who are not mechanics, but who can consider the difference in price between a plain and clutch pulley equal to the greatest expert known to modern science, although they do not understand the difference in actual practice, it proves that plain directions along this line are very much needed.

After the second cylinder is added to the single engine, converting it into a double engine, it is not always necessary to run both of them, for if only a light load is to be carried for several days the connecting rod may be disconnected from the crank pin on one side and the valve gear may also be allowed to remain at rest while the other side carries the load.

With such an engine it is possible to carry loads that vary greatly, not only as shown by these calculations, but beyond the limits herein mentioned, for when the greater power is developed the cut-off takes place at one-sixth of the stroke, which may be exceeded and still secure a fair degree of economy. The extreme limit is still farther on, but so far as fuel is concerned it does not pay to overload an engine.

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SETTING TYPE BY TELEGRAPH.

The paper recently read by Mr. Donald Murray, before the Institution of Electrical Engineers in England, indicates a distinct advance in the science of telegraphy, and shows that the author has grasped the general principles which must govern the conditions under which fast speed working is commercially practicable. The expression "fast speed" is greatly misunderstood, and many of those who are experts in telegraph mechanism fail to understand the conditions under which fast speed can be made of commercial value. The one idea of these experts is to produce an apparatus which can "pour out" signals at a speed which has not hitherto been attained, utterly oblivious of the fact that the possibility of "handling" the received signals, transscribing the same and putting the result in an intelligible form for handing to the public, is a matter of vital importance. By some telegraph experts, the necessary commercial conditions are well understood, and the lines on which they are working are therefore perfectly sound; this is notably the case in regard to the Murray apparatus. Mr. Murray has continued to improve the instruments, with the result that the system is likely to prove of sterling value. In his paper, Mr. Murray points out that the object of machine telegraphy is not only to increase the saving of telegraph wire, but also to reduce the labor cost of translation and writing, by the use of suitable machines. The simplicity of these machines and the saving of wire-cost depend on the fewness and simplicity of the signals. For a given wire, the fewer the signals the more the business that can be passed over it; and for a given amount of business, the fewer the signals the cheaper the wire that can be used. And with the increase of distance the cost of the wire becomes all-important.

Although the Morse alphabet is ideal for manual signaling, it has a grave disadvantage for machine telegraphy. The letters are of unequal length. Only those who have made a careful study of the printing telegraph problem from a mechanical point of view, can realize the extreme importance of this question in constructing a printing telegraph. Uniformity is the key to success in machinery. It makes for simplicity. With all machinery, simplicity, other things being equal, is of prime importance, and owing to the delicacy and inherent imperfection of telegraphic machinery, the need for simplicity in this case is overwhelming. That simplicity can only be secured by a signaling alphabet in which all the letters are of equal length. It is the same necessity that has compelled the use of letters all of the same width in typewriters. The Morse alphabet, however, has been in possession of the field so long, and telegraph officials in English-speaking countries are so saturated with Morse traditions, that it would be impossible to introduce a new alphabet if the operators had to learn it. Fortunately, with machine telegraphy that is not the case. As a single illustration of the mechanical advantages of an equal-letter alphabet, such as that used on the Baudot and Murray systems, it may be mentioned that a keyboard perforating instrument to produce the Morse tape for the Wheatstone transmitter, requires a group of 19 punches and their corresponding parts, as against only five punches and their corresponding parts in the Murray keyboard perforator. As an automatic printing telegraph requires about four keyboard perforators at each end of a circuit, if an equal letter keyboard perforator can be constructed for $100, and an unequal letter perforator costs $300, there is a difference of capital cost of about $1,500 per circuit in favor of the equal-letter alphabet. This is a large item if many circuits have to be equipped, to say nothing of the fact that cost of maintenance is roughly proportional to capital cost.

Unquestionably the best alphabet for machine telegraphy is that used in the Baudot and Murray systems. It is the shortest of all practicable telegraph alphabets, in fact, the shortest possible, and it is an equal-letter alphabet, consisting of five units per letter. The permutations are made up out of impulses of 1, 2, 3, 4 and 5 units' duration, both positive and negative (or positive and zero). Being an equal-letter alphabet, the signals can be divided off into letters by measurement. There is, therefore, no need for a unison signal to separate the letters as in Morse. Hence there is no space between the letters. The result is that impulses frequently extend from one letter into the next, and the average number of marking impulses per letter in the Murray system is only about 1¼, and a trifle more in the Baudot.

The Murray system makes no attempt to secure synchronism. It is an isochronous system, and the duplex balance is used to secure working in both directions on one wire, the Murray system, like the Wheatstone, working very easily in this manner. Retardation under these circumstances ceases to be important, because the distributor need only keep step with the arriving signals, which might, if necessary, take five minutes on the journey. This arrangement has also the advantage that ordinary repeating stations can be used.

So far as commercial telegrams are concerned, a serious objection to direct-transmitting page-printing telegraphs is that errors show up badly in the printed message, and operators have to work slowly and carefully to avoid making mistakes. Telegraph operators are remarkably accurate, but in spite of the best care and skill errors are frequent. Any one who is accustomed to using a typewriter knows how difficult it is to write a page of typewritten matter without striking at least one or two wrong letters. In four cases out of five there is consciousness of the error as soon as it is made, and steps can be taken to correct it. In tape-printing telegraphs, like the Hughes and Baudot, the errors and the succeeding corrections can be cut out of the tape before it is pasted on the telegraph blank, and there is then nothing to disfigure the telegram and make the recipient uneasy about its accuracy. With a direct-transmitting page-printing telegraph this cannot be done. A wrong key depressed is an error printed at the other end of the line, and the correction following only magnifies the blot. All automatic systems of telegraphic transmission in which there is preparation of the message beforehand possess the potentiality of correcting an error before transmission. In the Wheatstone automatic system, for instance, this process is known as a "rub-out." When an operator at a Wheatstone puncher makes a mistake he can pull the tape back and punch it full of holes, thereby obliterating the mistake. In this case the mistake is represented by a series of dots on the receiving tape and the transcribing clerk passes over it. In automatic telegraph systems, in which a printing machine takes the place of the receiving operator, it is a comparatively simple matter to arrange that the printer shall imitate the action of the operator by remaining inactive when dots only are coming over the line. In this way no trace of the error appears in the printed message. This, for instance, is done in the Buckingham system. In the Buckingham system, however, as with Morse, the groups of letter signals on the transmitting tape are of varying length. It is consequently not possible to pull back the transmitting tape letter by letter in the keyboard perforator. It has to be adjusted by hand, or pulled back unit by unit, a process necessarily involving some loss of time, and many corrections in this way would materially reduce the output of the operator. In the Buckingham system also it is necessary to rub out everything as far as the end of the previous line. Hence, to correct a single letter a whole line may have to be rubbed out. With automatic systems like the Murray, using an alphabet in which the letter signals are all of the same length, the transmitting tape, while being prepared in the keyboard perforator, can be pulled back instantly letter by letter by depressing a lever. If an operator strikes a wrong key all he has to do to rectify his error is to strike the back-spacing lever, the letter-shift key and the desired letter—the work of a moment. A word of six letters can be blotted out in this way in a few seconds, and no trace of the correction, not even a blank space, will appear in the printed message at the other end of the line. This relieves the operator from the dread of striking the wrong key, the strain on his attention is less, and he can work faster without working harder. One or two automatic typesetting patents have included schemes for correcting errors in the perforated tape; but the Buckingham appears to be the first printing telegraph to adopt a plan for invisible correction, and the Murray system was the first, and, so far, is the only system having the power to correct instantly single letters or words.

The key buttons are in rows of different colors and of slightly different heights to facilitate operations without taking the eyes off the copy—an essential condition for high speed on a typewriter keyboard. This mode of working is not so difficult as might be supposed, particularly when the operator is trained from the first to write in this way. A young operator in Berlin learned to write on one of the Murray keyboards in a fortnight, at the rate of 120 letters (20 words) per minute, without looking at the keyboard, and this operator, after several months' practice, reached a speed of 436 letters (72 words) per minute in the same way. This is an exceptional case, and the operator was accustomed to piano playing, but it illustrates the possibilities of this method.

The speed of the Murray printer is now not less than 900 letters (159 words) per minute, and the automatic portion of the mechanism runs perfectly up to 200 words a minute. Unfortunately, however, no typewriter yet constructed will stand the strain of more than about 720 letters (120 words) a minute in continuous service. The received tape may be divided into sections and run through two printers when the apparatus has to be worked at top speed. Under existing conditions, however, high speeds for handling commercial messages are for many reasons undesirable, and a maximum of 120 words a minute in each direction seems to meet all requirements.

In practice with the Murray system—as with all other telegraph systems, from the Morse key upwards—the average output is not more than about 50 per cent. of the maximum. Time and patience will no doubt stop some of the leaks; but others, such as errors caused by line interruptions, seem to be incurable. The experience of the British Post Office is that five operators at each end of a Murray circuit, equipped with the apparatus in its original form, can exchange about 200 telegrams an hour, and under favorable circumstances occasionally as many as 240 per hour. With the new motor-driven printer, with automatic line feed, invisible correction of errors and other improvements, it is estimated that it will be possible for six operators at each end of a Murray circuit to exchange about 300 messages an hour. That is to say, 12 operators on one circuit will be able to do the work of 16 men on two Morse quadruple circuits, or at lower speeds eight operators will be able to do the work of 12. Actual tests show that the improved printer has a maximum speed of five messages a minute, so that the working average may be safely put at 150 messages an hour. A weak point with many telegraph systems is durability. In this respect the Murray apparatus has proved satisfactory.

Japan Increases Duty on Electrical Apparatus.

Electrical manufacturers will be interested to learn that a new tariff law has been enacted by the Japanese Diet and that it will go into effect July 1 next. A general increase of duties is noted all through the new law, presumably to enable Japan to gain additional revenue for the prosecution of the war with Russia. The new rates on electrical apparatus are as follows: Electric light apparatus and instruments and parts thereof, 15 per cent. ad valorem; telephones and parts thereof, 15 per cent.; copper wire, 15 per cent.; submarine telegraphic cables and underground telegraphic lines or cables, 20 per cent.

Crocker-Wheeler Company's Co-operative Plan.

A new co-operative scheme has been entered into between the officers of the Crocker-Wheeler Electric Company of East Orange, N. J., and its employes. It is in the nature of a benefit association. The men pay 10 cents a week. Each member is entitled to $10 a week for 20 weeks during disability and his family will receive $100 when he dies. The company will contribute an amount equal to the dues paid to the association.

AS OTHERS SEE US.

(From the "American Contractor," Chicago, April 1, 1905.)

A LIVE ELECTRICAL JOURNAL.

In these days when publications have multiplied to such an extent that no field, developed or prospective, is left unrepresented, class journals are liable to become narrow and uninteresting, except to those whose business follows the same general line. In other words, they are likely to contain too much distinct "shop" talk, and that presented in a too highly condensed form. But there is such a thing as publishing a newspaper which, while fairly entitled to that name and containing everything of real value from a scientific standpoint in the field it essays to fill, may prove of decided importance from a trade and commercial standpoint, interesting and enlightening the reader. Within this category must be placed ELECTRICITY, the well-known New York journal.

This paper, which must be accounted old in a field that is really new, amply justifies its title, and, without being technical, keeps its readers informed on all interesting and valuable occurrences in the world of electricity. It contains a large amount of original matter, written in an intelligible and entertaining way, from which one may secure ideas without employing a reference library. Attentive readers of this paper will overlook nothing of great value in the electrical line.

A GOOD WORD FROM MAINE.

OLD ORCHARD, Me., March 13, 1905.
Electricity Newspaper Company :

Inclosed please find one dollar for one year's subscription to ELECTRICITY. Was much pleased with sample copy and the promptness with which I received it. It compares favorably with journals which I am taking whose subscription price is three times that of ELECTRICITY.

Yours respectfully,
CLYDE R. L. SNOW.

A Book Worth Having.

The well-known concern, G. & C. Merriam Company, of Springfield, Mass., has recently placed on the market a new edition of Webster's dictionary, which should be in the hands of all business and professional men. This revised work, known as Webster's International Dictionary, was edited by W. T. Harris, Ph.D., LL.D., United States Commissioner of Education, and contains 25,000 new words and phrases. There are 2,380 quarto pages, and 5,000 handsome illustrations from new plates. It may or may not be generally known that Webster is now, and has been the standard authority in the Government Printing Office for the last 30 years.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED APRIL 4, 1905.

Electric Railways and Appliances.

786,316. Signal System for Railways. William G. Roome, Los Angeles, Cal. Filed Dec. 19, 1904.

786,368. Railway Signaling System. Joseph Lemire, Drummondville, Can., assignor, by direct and mesne assignments, to the Automatic Railway Signal Company, Limited. Filed Oct. 3, 1904.

786,489. Automatic Trolley-Pole Controller. Martin O. Dolson, Los Angeles, Cal. Filed July 28, 1904.

786,604. Railway Signal System. William E. Schieble, Miamisburg, O. Filed May 16, 1904.

786,628. Electric Indicator for Railways. Pierre I. Chandeysson, North Judson, Ind., assignor, by mesne assignments, to Robert D. Peters, Knox, Ind. Filed Feb. 13, 1904.

Electric Lights and Appliances.

786,518. Electrode for Arc-Lamps and Method of Making Same. Isaiah L. Roberts, New York City. Filed March 25, 1903.

786,727. Apparatus for the Manufacture of Glowers for Electric Lamps. Francis M. F. Cazin, Hoboken, N. J. Filed Feb. 2, 1903.

Electrical Machinery and Apparatus

786,320. Means for Rectifying Alternating Currents. Robert Siegfried, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Feb. 12, 1904.

786,323. Electric-Motor Control. William D. Stivers, Jersey City, N. J., assignor to the C. W. Hunt Company, West New Brighton, N. Y. Filed Nov. 12, 1904.

786,325. Electrical Condenser. Percy H. Thomas, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed July 16, 1903.

786,338. Transformer Receptacle or Case. John H. Zimmerman, Newark, N. J., assignor to the Westinghouse Electric & Manufacturing Company. Filed April 18, 1903.

786,366. Bearing for Electric Meters. Darragh de Lancey and Herbert M. Smith, Great Barrington, Mass., assignors to the Stanley Instrument Company, same place. Filed Sept. 17, 1903.

786,378-379. Mechanical-Power Brake and Power-Brake. Louis Pfingst, Boston, Mass., assignor to the Pfingst Electric Manufacturing Company, Kittery, Me. Filed Jan. 23 and July 13 1904.

786,411 to 786,425. Magnetic Clutch or Speed-Accelerator, Method of Power Transmission, Alternating-Current Power Transmitting Apparatus, Synchronous Motor With Clutch, Method of Varying the Speed of the Load Driven by an Alternating-Current Motor, System of Operating Electric Vehicles Electric Speed Accelerator, System and Apparatus for Motor Control, and System of Controlling One or More Electric Motors. Henry H. Cutler, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company, same place. First application filed Aug. 5, 1903. Latest application filed July 2, 1904.

786,506. Motor-Controlling Switch. Frederick Mackintosh, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 17, 1904.

786,635. System of Control for Electric Motors. Arthur C. Eastwood, Cleveland, O. Filed March 21, 1904.

786,752. Circuit-Controlling Device for Motors. George W. Gilmore, Alliance, O., assignor to the Alliance Machine Company. Filed Sept. 15, 1904.

786,775. Electric-Motor Controlling Apparatus. Lars G. Nilson, Hoboken, N. J., assignor, by mesne assignments, to the Fisher Motor Vehicle Company. Original application filed May 15, 1902. Divided and this application filed June 10, 1904.

Telephones and Telephone Apparatus.

786,263. Telephone Attachment. Louis A. Bumgardner, St. Paul, Minn., assignor of two-thirds to John Dale and Francis C. Peabody, same place. Filed Aug. 16, 1904.

786,428-429. Selective Signaling System. Rudolph C. Deuben, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed May 18 and Oct. 2, 1903.

786,444. Telephone-Transmitter. William Kaisling, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed Nov. 23, 1903.

786,523. Telephone-Receiver Holder. Kate C. Seaman, New Orleans, La. Filed April 9, 1904.

786,588. Telephone-Receiver. William J. Murdock, Boston, Mass. Filed July 21, 1904.

786,589. Circuit Closing and Breaking Device. William J. Murdock, Boston, Mass. Filed July 21, 1904.

786,733. Memorandum Attachment for Telephones. John W. Currier, Boston, Mass. Filed Jan. 11, 1905.

Miscellaneous.

786,257. Electric Heater and Method of Manufacturing Same. Murray C. Beebe, Pittsburg, Pa., assignor to George Westinghouse, same place. Filed May 14, 1900.

786,376. Electrogasoline-Vehicle. Lars G. Nilson, New York City, assignor, by mesne assignments to the Fischer Motor Vehicle Company. Filed May 15, 1902.

786,396. Induction-Coil. Charles Adams-Randall, New York City. Filed Dec. 22, 1903.

786,542. Electric Heater. Louis P. Brown and Frank J. Holmes, Chicago, Ill. Filed Oct. 17, 1904.

786,577 Thermo-Electric Couple. Albert L. Marsh, Lake Bluff, Ill., assignor to William A. Spinks & Co., Chicago, Ill. Filed Oct. 18, 1904.

786,578. Combined Condenser and Leak-Coil. Walter W. Massie, Providence, R. I. Filed June 18, 1904.

786,696. Signal-Relay. Frederick K. Vreeland, Montclair, N. J. assignor to the Wireless Telegraph Exploitation Company, New York City. Filed Nov. 14, 1904.

785,704. Galvanic Battery. David L. Winters, Chicago, Ill. Filed Jan. 3, 1905.

785,776. Electroplating Apparatus. Louis Potthoff, Flushing, N. Y. Filed Dec. 1, 1904.

THE TELEPHONE WORLD.

Bell Company Surrenders to Independents.

After a fight that has continued over 10 years the American Bell Telephone Company has made its first surrender to the Independent companies in Iowa. It has always been the policy of the Bell Company to refuse to connect its lines or exchanges with others using any except Bell instruments, on which a high royalty is charged. The fight has resulted in the country being covered with a network of rival lines and rival exchanges being built in cities.

The Bell has defeated legislation in many States to compel connections. Now it is announced that the Bell Company has contracted with several Independents for connections, and will make the policy general. The Iowa Independents consider the victory finally won, and are jubilant. The struggle has cost millions to both sides.

Lower Telephone Rates in Illinois.

A recent meeting of the Central Illinois Independent Telephone Association has resulted in the adoption of a uniform toll rate for long-distance calls by the Independent companies. The new rate is from 25 to 50 per cent. lower than those at present in force.

For more than a year the Citizens' Telephone Company, of Racine, Wis., has contemplated the building of a new central station and installing of a new system. Deals have now been completed for the improvement. The building, costing between $12,000 and $15,000, will be modern in every particular. The Citizens' Company will expend between $50,000 and $100,000, and claim its lines will be the best and most perfect in use. At present it has close to 2,300 'phones rented. It is understood that the company will soon have connection with a toll system to extend all through Wisconsin, up as far as St. Paul, Minn., and south into Illinois. The Wisconsin Telephone Company will put in many new cables and make other improvements, its intention being to reach out for more business in Racine and vicinity.

The Independent Telephone Company is making preparations to test the rural telephone rate law passed by the last Kansas Legislature. The law provides that farmers who own and maintain their lines shall only pay 50 cents a month rent, instead of $1, as they have been doing heretofore. As the law is aimed at Lyon County and was passed at the instigation of Emporia farmers, the telephone company claims that it is class legislation and will try to get it revoked on this ground. On the other hand, the farmers are equally sure that the law will stand, as the company has a State charter, and the cut rate, although applying only to Lyon County, is a State law.

A number of business men of Noblesville, Ind. together with several Indianapolis and Cincinnati men, have organized a telephone company with a capital stock of $100,000, and will soon ask the council for a franchise to enter Noblesville. It is their intention to extend the lines throughout the country. No tolls will be charged to talk to any part of the county and the price of telephones will be reduced 25 per cent.

Independents Will Hire an Organizer.

The Ohio Independent Telephone Association, at its meeting in Columbus last month, decided to employ a salaried organizer, and the executive committee was empowered to make such other expenditures as might be necessary to promote the interests of the association.

To raise funds for this purpose the association made itself liable to an assessment for emergency purposes of not to exceed four cents per telephone in active service.

These officers were elected:

President, Frank L. Beam, Cleveland, and secretary-treasurer, Ralph Reamer, Columbus.

Plans are being made by capitalists of Willows, Cal., to build a telephone line from Elk Creek to Round Valley. This line will traverse a rich lumbering and cattle country, which has heretofore been without telephonic communication and will be of great benefit to the town of Covelo and the Government reservation in Round Valley, bringing them in touch with the outside world. Another undertaking is the building of a telephone line to Fouts Springs, from Willows, adding greatly to the convenience of several health resorts in Western Glenn and Colusa Counties.

Work on the first of a series of "farm" telephone lines, to be constructed by the Central District & Printing Telegraph Company into the rural districts of Allegheny County, Pa., has been started in Mifflin and North Versailles Townships. The lines are being built especially for farmers and others living in the country districts. The line into Mifflin Township will be connected with the Homestead exchange, and extended through South Homestead, Homestead Park, Lincoln Place, Bull Run and other districts, reaching almost into Greene County. The North Versailles line will be connected with the Turtle Creek exchange, and will extend over the hills and include the territory between Turtle Creek, McKeesport and Irwin. Another line has been built through Patton and Braddock Townships, north of Turtle Creek, including the territory on the Greesburg pike from Pitcairn to Wilkinsburg.

Telephone instead of telegraph orders now govern the operation of trains over parts of the central division of the Philadelphia, Baltimore & Washington Railroad.

The Colorado Telephone Company, of Denver, has filed incorporation papers, the capitalization being $10,000,000. A part of the company's operations will be in New Mexico, with headquarters at Albuquerque.

The citizens of Council Bluffs, Ia., recently voted to grant a franchise to the Independent Telephone Company. Out of a total vote of 2,809, there were but 962 cast against it.

The Milwaukee Railroad Company has decided to displace the telegraph with telephones at the stations at Millville, Hammond and Zumbro Falls, Minn.

The Home Telephone Company's new long-distance line between Downey and Los Angeles, Cal., was lately opened for business.

Automatic Electric Company's Contract.

An item appeared in the issue of ELECTRICITY of March 29 stating that the Automatic Telephone Company, of Chicago, had been awarded the contract for a private telephone system in the New Orleans, La., Naval Station. The company to whom the contract was awarded is the Automatic Electric Company, of Chicago, instead of the one mentioned.

The annual financial report of the Gainesboro Telephone Company, with headquarters at Sparta, Tenn., has been issued. The report shows the growth of its lines from a few miles in 1896 to 2,200 miles of line, and 25 exchanges at present. The capital stock paid in is $214,700. The operating and maintaining expenses and taxes last year were over $26,000, the gross revenue was $47,357.43, the dividends amounted to $10,093.50, and a reasonable amount was paid to the depreciation fund. The lines of this company extend through Tennessee and Kentucky. Its rates are materially below those proposed to be fixed by the Legislature.

A meeting of the stockholders of the Maryland Telephone Manufacturing Company in Baltimore has been called for May 1, to take action on the decision of the directors to dissolve the corporation. The company was organized for the purpose of manufacturing instruments and equipment for the Maryland Telephone Company, and its stockholders and officers are identified with the latter company. The February fire of last year burned out its plant and since then it has not been in operation

The Bertha Telephone & Telegraph Company has been organized in Opelousas, La, with a capital stock of $50,000. The company succeeds the Bertha Telephone Company, and will install a complete modern plant and extend its long-distance lines. The following are the officers: Albert B. Pickett, president: Charles B. Chachere, vice-president; Daniel L. Baker, secretary and general manager, and Paul A. Blanchard, treasurer.

With a capitalization of $10,000, the Buffalo, N. Y., Pole Line Construction Company has been formed to manufacture electric and telephone materials. The incorporators are W. E. Robertson, C. S. Saunders and A. G. Greenberg, all of Buffalo.

The Hager Telephone Company has been organized to build a telephone line from Hager City to Diamond Bluff, Wis., thence down the Trimbelle Valley. The officers are: President, Frank Way; treasurer, N. P. Jensen; secretary, J. W. Milton.

Telephone Incorporations.

The Cato & Meredian Telephone Company, Cato, N. Y.—to operate a line in the northern part of Cayuga County and a part of Seneca, Wayne and Onondaga Counties. Capital stock, $25,000. Incorporators: J. E. Casey, G. R. Hageman and J. K. Rich, all of Cato.

The Marissa Farmers & Merchants' Telephone Company, Marissa, Ill. Capital stock, $10,000. Incorporators: G. W. Norin, S. S. Boyle and W. E. Meek.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Carlisle, Ky.—A new stock company, with C. C. Cole as president; M. V. Bostain, vice-president; George A. Straus, secretary; John N. Riss, treasurer, has been organized for the erection of a new and modern up-to-date electric light plant to cost not less than $15,000. Work has begun and light is promised in 60 days, barring serious accidents.

Chatham, Ill.—Mr. Carr is making plans for establishing an electric light plant.

Columbia, Ky.—It is now an assured fact that this place is to have an electric light plant. Mr. W. R. Myers has purchased a plant with power sufficient to light the town.

Conrad, Ia.—W. J. Stanton is projecting an electric light plant for this city.

Connersville, Ind.—The Connersville Gas, Electric & Power Company was lately sold at receiver's sale to George B. Markle, of Hazleton, Pa.

Dayton, O.—The Dayton Electric Light Company, of which Dr. J. E. Lowes is president, and the Montgomery County Electric Light Company, which was recently incorporated, have been consolidated under the name of the Dayton Lighting Company. The new concern will have a capital stock of $2,500,000. A million dollars will be spent in equipment.

Ebensburg, Pa.—A new town will be built within one mile of this place. Among the modern conveniences will be an electric light plant.

Eldorado, Ark.—Poles have been erected and wires strung for the electric light plant here.

Escanaba, Mich.—Municipal lighting has proved a failure in this city, and by unanimous resolution of the common council the proposition of selling the city electric and gas plants to the highest bidder will be submitted to the voters at the spring election to be held this month. The property represents an investment of about $80,000.

Fenton, Mich.—The electric light and telephone systems here were considerably damaged by a recent thunder storm.

Jamestown, N. D.—The Jamestown electric light plant is to be enlarged and improved.

McKeesport, Pa.—An electric light plant is to be erected in this city this spring.

Milton, Wis.—Prominent citizens of this place and Milton Junction are talking strongly of organizing an electric light and power company for the two places.

Montreal, Can.—The city council of Calgary has authorized the installation of an electric plant for street lighting at a cost of $60,000. R. S. Kelsch, of this city, is consulting engineer.

New Franklin, Mo.—The action of the city council in granting an electric light franchise to T. H. Todd and Wallace Estell, of this city, was ratified by practically a unanimous vote of the citizens at a special election held for that purpose last month.

New Paltz, N. Y.—Electric lights are to be installed here.

Pennsburg, Pa.—The council has granted an electric light franchise to a stock company.

Wernersville, Pa.—The Wernersville Electric Light, Heat & Power Company, with a capital of $5,000, has been incorporated.

Woodhull, Ill.—Fire lately destroyed the electric light plant here.

STREET RAILWAYS.

Albany, N. Y.—The Wallkill Transit Company of Middletown (reorganizing the Middletown-Goshen Electric Railway Company) has been incorporated. Its capital stock is $350,000, and directors: W. M. Oglesby, Harrisburg, Pa.; H. B. Royce and M. Benjamin, of Middletown. N. Y.

Baraboo, Wis.—C. C. Downer of the Red River Valley Electric Railroad Company has been trying to secure a right-of-way from Clintonville to Antigo via Eland Junction.

Carlisle, Pa.—The Cumberland Valley Railroad Company will equip all of its branch lines with the third rail for electric service.

Charlevoix, Mich.—There is talk of building an electric line this spring from Norwood to this city, a distance of three miles.

Columbia, Ind.—The proposed electric line from here to Goshen will run directly north from Syracuse to Benton.

Decatur, Ill.—Henry W. Knight has organized a company for the purpose of constructing an electric line connecting this city with Bloomington.

Gulfport, Miss.—The Gulfport & Mississippi Coast Traction Company proposes to build an electric line connecting the coast towns of Gulfport, Pass Christian and Biloxi. The company has been organized with a capital stock of $1,000,000.

Hagerstown, Md.—Official announcement of the purchase by the Cumberland Valley Railroad Company of the Chambersburg & Gettysburg Electric Railway system was lately made by M. C. Kennedy, vice-president and general manager of the Cumberland Valley Railroad Company.

Joliet, Ill.—This city and Pontiac will be connected by an electric railroad soon.

Kansas City, Mo.—The Kansas City & Leavenworth Electric Railroad has been sold to Clarence S. McClelland, of Mount Vernon, N. Y.

Lakewood, N. J.—Abner P. Gant, of this place, and L. D. Van Note and Robert Allen, of Point Pleasant, have been appointed commissioners to condemn lands near here for the Trenton, Lakewood & Atlantic Railroad Company's right of way for the trolley line from this place to Point Pleasant. Work is in progress and Lakewood will soon be connected with the seashore by trolley.

Lewisburg, W. Va.—A trolley line will be constructed between this city and Ronceverte.

Long Island City, N. Y.—By the time the season opens, in June, the Long Island Railroad Company expects to have its electrical equipment on the Far Rockaway branch and the line across the Jamaica Bay trestle to Hammels and Rockaway Beach fully installed.

Mannington, W. Va.—The city council has granted a franchise to the Mannington Light & Power Company for the purpose of constructing an electric line in this city.

Niagara Falls, N. Y.—At an early date the inclined railway in Prospect Park will be operated by electricity instead of hydraulic power.

Rockville Center, N. Y.—The South Shore Traction Company has been granted a franchise for a trolley road along the route proposed by it.

Sea Cliff, N. Y.—A number of local business men will petition the Long Island Railroad Company to make a trolley connection between the beach and this village.

Spearfish, S. D.—Articles of incorporation have been filed for a company which will finance the electric trolley line between this city, Belle Fourche and the Northern Hills towns. The stock will be sold to business men, and it is expected the road will be in operation before January 1.

Syracuse, N. Y.—A recent report from Rochester states that the Westinghouse-Kerr-Church Syndicate, which recently purchased the Rochester & Eastern Electric Rairoad, running between Rochester and Geneva by the way of Canandaigua, had secured the Geneva, Waterloo & Seneca Falls road, which extends from Geneva to Seneca Falls, giving it a line from Rochester to Seneca Falls. The report revived the rumor that the Geneva, Waterloo & Seneca Falls road would be extended to Auburn, the only gap in the trolley system between Rochester and Syracuse, through the territory covered by the Auburn branch of the New York Central. Such an arrangement would doubly connect this city with Rochester by trolley, the Rochester, Syracuse & Eastern road now building practically parallel to the main line of the Central.

POWER PLANTS.

Decatur, Ind.—The Springfield-Fort Wayne Interurban Company, of which W. H. Fledderjohn is manager, will erect a new power plant in this city.

Indianapolis, Ind.—The erection of a power plant in the heart of the Indiana coal field, for the generation of enough electricity to furnish all the power needed by the traction lines of Southern and Central Indiana, is a project that has been proposed to traction men of this city.

Minneapolis, Minn.—The Minneapolis General Electric Company will erect a new power plant which will furnish 24,000 hp. The sum of $3,500,000 is to be expended.

Ohiopyle, Pa.—The harnessing of the Ohiopyle Falls is again being agitated and this time the Wheeling, W. Va., men, who are behind the scheme, are said to have enough enterprise and money to put the matter through.

Pentwater, Mich.—Business men interested in the forming of a company to furnish electric current for lighting and heating purposes by water power have been making investigations of the possibility of damming the Pere Marquette River, near Colfax Township line, where the river is very narrow and hills on both sides. If this is accomplished, power, heat and light could be furnished to all the towns and villages of both Oceana and Mason counties.

BIDS WANTED.

Meridian, Miss.—Bids will be received May 1 for furnishing 200 arc lights, 1,200 cp., for a period of five years from May 1, 1906. Bids will also be received at the same time for other lamps. Address J. H. River, mayor.

Newport, Ky.—Sealed bids will be received by Peter J. Krebs, city clerk, until April 14, for furnishing and installing a storage battery system.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15¼@15⅜c.; casting, 14⅞@15c.

The "conservative, strong interests" in General Electric say the stock will cross 210 in June.

The Everett-Moore electric railway companies in Ohio are reporting increased earnings for the month of March.

An official of the National Carbon Company says there is fair prospects of another dividend on the common stock in May or June.

The Massachusetts Railroad Commission has authorized the Boston Elevated Company to issue $7,500,000 4 per cent. 30-year bonds.

The New York Assembly Railroads Committee has reported favorably the Dale bill, providing for a 3 per cent. State tax on the gross earnings of street railways.

The Brooklyn Rapid Transit Company has applied to the New York Stock Exchange to list $1,750,000 additional refunding mortgage 4 per cent. bonds of 2002.

The Boston Stock Exchange has listed 47,969 shares of common stock and 47,119 shares of the preferred stock of the Boston Suburban Electric Companies.

Opposition to the proposed sale of the Springfield (Mass.) Street Railway has agreed to pool the stock with a view to obtaining better than $225 per share—offered by New Haven.

The Massachusetts Railroad Commission has authorized the Boston & Northern and Old Colony street railway companies each to issue $500,000 additional stock at $100 a share.

The most interesting feature in copper circles is the report that large sales, probably about 10,000 tons, of electrolytic have been made for export, mainly to Europe, during April and May.

The Brooklyn Rapid Transit Company has made a bid to construct subways, and in financial circles it is believed that the company has entered into a combination with the Metropolitan system of New York.

The Electric Textile Machinery Company has been incorporated under Massachusetts laws with a capital of $1,000,000 to deal in textile machinery. Of the capital $300 was paid in in cash and patents were represented by 99,997 shares.

A special meeting of the Philadelphia Rapid Transit Company's stockholders has been called for April 25, to authorize the company to join as surety and guarantor in a mortgage of the Market Street Elevated Passenger Railway Company.

There is talk of a combination between the American Locomotive Company and the General Electric Company, based on the fact that the two companies have a great many joint orders for electrical locomotives and the belief that this department will grow materially.

The Gas & Electric Company of Bergen County, N. J., recently voted to make a new $5,000,000 mortgage to replace the one made November 1, 1904, with the Bowling Green Trust Company, trustee, and authorized the exchange of the $800,000 bonds issued thereunder for a like amount of bonds to be issued under the new instrument.

Of the new $1,250,000 issue of 5 per cent. 20-year bonds of the Columbus, Newark & Zanesville (O.) Electric Railway Company $400,000 have been taken by Baker, Ayling & Co., Boston, and $800,000 by the Electrical Securities Corporation of New York, the Union Electrical Securities Company and the Railways & Securities Company of Boston. There are still $750,000 reserved for extensions.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price April 8.
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	209
Manhattan Elevated Railway	166½
Metropolitan Street Railway	122¾
Metropolitan Securities	86¾
Ninth Avenue	197
Third Avenue	131
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	69⅞
Brooklyn City Railway	239
New Orleans Railway	4½
Public Service Corporation (New Jersey)	141
Philadelphia.	
Consolidated Traction of New Jersey	83
Philadelphia Traction	100
Union Traction	59
Boston.	
Boston Elevated	156
Massachusetts Electric Companies, com	20¾
do. do. do. pref.	68¾
West End Street, com	97½
do. do. do. pref.	116
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	10
do. do. pref.	45
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	17½
do. pref.	61
Electric Boat, com	41
do. do. pref.	78
Electric Lead Reduction	½
Electric Vehicle, com	12⅛
do. do. pref.	24
Westinghouse, com	181
do. pref.	192
General Electric	188½
Boston.	
Edison Electric Illuminating	256½
General Electric	188½
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	170
National Carbon, com	53½
do. do. pref.	115
Philadelphia.	
Electric Company of America	12¼
Electric Storage Battery, com	87
do. do. do. pref.	87
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	145
Western Telephone Company	19
New England Telephone Company	139
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210½
Mexican Telephone Company	1⅞
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93¼
Chicago Telephone Company	137½
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Otis Elevator Company	49
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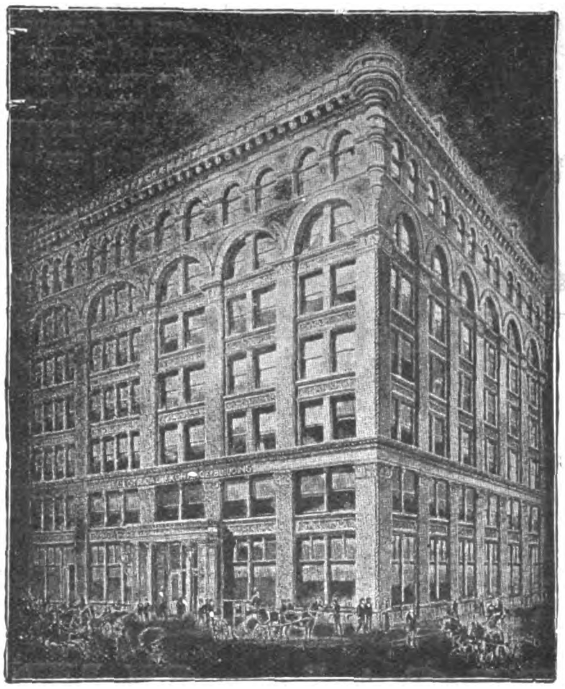

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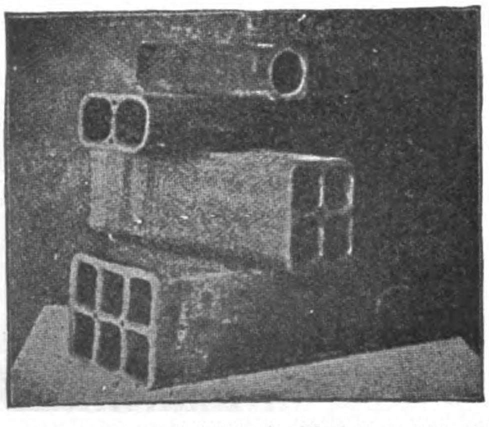

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ELECTRICITY.

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EDITORIAL NOTES.

The Electrical Safety of New York.

The word electricity to the layman means shock, and to the ignorant, sudden death. New York now represents such a complicated network of wires overhead and underground, that to some extent at least a natural fear has been aroused in the minds of many citizens that danger lurks on every side. The deadly third rail, the fatal electric light wire are common expressions. To what extent life is unsafe in New York through the electrification of its surface, elevated and underground roads, through the installation of hundreds of thousands of incandescent, and many thousands of arc lamps, is well worth inquiring into. If unsafe, why is so great an evil allowed to remain. But if the electrical safety of New York is an assured fact, then such misconceptions should be dispelled. They belong to the traditions of the past.

The requirements as regards insulation are so rigid in the electrical equipment of new buildings that from this source at least no danger can be expected. The iron conduit system is thoroughly efficient as a measure of protectiveness. The same reasoning applies with equal force to the subterranean system of conduits extending from one end of New York to the other. Lead-covered cables carry the electrical energy from point to point, and the danger from any cause whatsoever is thus reduced to a minimum. But if the wires are so well insulated, does it necessarily follow that this insulation is employed as a protection for the sake of the public against accidents? We hardly think so, and for reasons which, with but two exceptions, will appeal to intelligent minds. These exceptions are the case of high tension alternating current wires, which are always underground and possibly from the third rail. A high tension alternating current is a deadly current to take and few are left to tell the tale after such an experience. But with the third-rail, conditions are different. Five hundred volts direct current is not deadly, in fact, railway men do not regard it as such, and would pass a matter of that kind by without a word. If the third-rail is at this pressure with respect to the other two tracks, then why do sensational reports appear about the deadly third-rail? We do not wish to destroy the deeply unplanted fear of our readers for their safety when such risks are present, but it is well worth knowing that contact with 500 or 600 volts is not necessarily fatal.

This assurance is of great value when accidents occur. It will at least act psychologically upon the will and give it resisting power. In some human organizations, a sensation that can only be interpreted as fear, will cause death. To such, mere contact with wires carrying moderate pressures would invite heart failure. Physiology and psychology are thus interlinked in their evil results, and as a proof of it, hundreds are alive and well through whose systems 500 volts have passed. New York is therefore electrically safe, and where high pressures are transmitted, safety is absolutely assured by the splendid underground conduit systems employed.

* * *

The Electrical Origin of Rain.

The vivid flash of a million volts and the short report or insistent rumbling are but the consequences of a chain of events which link this sphere of ours to the gigantic father planet, the sun.

In the light of our present knowledge we speak advisedly when we say the earth and sun are linked together by bonds of indestructible ether. Not only are they linked together, but the least indication of disturbances on the sun finds its echo in the far distant abysses of space. This earth and all the other satellites are instantly affected, and the terrestrial equipoise is temporarily disturbed, responding to invisible stimuli that advance like gigantic tidal waves upon surrounding heavenly bodies.

The cyclonic storms sweeping over the sun's surface are of almost incomprehensible grandeur. Great cataclysms of fire and incandescent vapor propelled by inward forces whose origin and character can be but faintly estimated rise to enormous heights. From these titanic pillars and flaming maelstroms are poured forth showers of corpuscles. They advance beyond the influence of gravitation and sweep across the ether bridge between the sun and earth with prodigious speed. With them, but far in advance, moving on with the swiftness of light are the infinitesimal vibrations awakened by these convulsions. It is like the exploration of a strange new land filled with wonders to look into the spectrum through the savant's eyes and view these pertubations of the ether with respect to their influence upon the existing order of things. To-day our greatest hope lies in an interpretation of natural phenomena through a comprehension of their functions. They awaken the twig and blossom, destroy the deadly germ and act as the most potent of forces in reconstructing the forms of inorganic matter. The rainfall is among the most important of all the phenomena directly attributable to the presence of the solar corpuscles. They are the nuclei around which the vesicle of vapor condenses, and this continuous and aggregated condensation is apparent in its final form as rain.

Strange as it may seem, science has advanced and in many respects proved this theory. The experiments of Sir Oliver Lodge have added their more convincing quota of evidence. He attacks the fog directly with his electric discharges, but the sun 92,000,000 miles away sends forth its myraids of messengers, each carrying its elementary charge of electricity which penetrate the banks of vapor accumulating in the higher strata of the earth's atmosphere. Here the drama of meteorological action transpires. The vast cumulus clouds are sprayed by this bird shot of nature, and the drops appear and fall to the distant earth. The inductive influences begin to operate as the process of condensation advances, and the charged clouds separating into mountainous masses of electrified vapor send into each other the forked flashes or silent sheet discharges so characteristic of the two degrees of condition.

The advance of spring heralds these events, and when in conjunction with this annual visitation we hear of the great sun spots lately witnessed, it is not too far-fetched to expect unusual disturbances in the upper atmosphere, not the least of which will be abundant lightning discharges.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Mayor Dunne of Chicago will probably organize his local transportation department along lines followed by private corporations.

Charles H. Baker of Seattle, Wash., will sail for China in May to engage in building a trans-China electric railway system in that empire.

A report from Montreal, Can., says that there is a movement on foot to have the Carillon and Grenville canals lighted by electricity.

The United States Circuit Court for New York in its decision in a suit by the Marconi Company against the De Forest Wireless Telegraph Company sustained the claim of the plaintiff company to the priority of the invention of a system of wireless telegraphy.

The Hotel Astor in this city makes use of the telautograph to transmit orders from the eighth floor, where all the large dinners are held to the ground floor.

The last reunion of members of the American Society of Mechanical Engineers in New York City, previous to the Scranton meeting, will be held on Tuesday evening, April 25, at 12 West 31st street. The paper of the evening will be by Mr. Gus C. Henning.

A cable dispatch from Frankfort-on-the-Main says that an amalgamation of the Lahmeyer Electrical Company and Felton & Guilleaume of Mulheim, Germany, has been effected, with a capital of $13,750,000.

The annual report on municipal ownership, to be presented by Mr. Arthur Williams to the Denver-Colorado Springs convention of the National Electric Light Association, will contain over 50 reports from foreign cities and towns, as well as a great quantity of information regarding municipal plants in this country. His report will be very voluminous and forms a notable addition to the literature relating to municipal electric lighting.

The seventh general meeting of the American Electrochemical Society will be held at Boston and Cambridge, Mass., Tuesday, Wednesday and Thursday, April 25, 26 and 27.

A dispatch from Watertown, N. Y., April 17, says: "Dr. Alfred Goss of Adams, as the result of long research in the realm of electro-therapeutics, is said to have worked out a treatment for tubercular troubles that promises the possibility of a cure. While the results of the treatment in the 44 cases that Dr. Goss has had are most gratifying, he says he is not yet prepared to state that the treatment is an assured success. Dr. Goss has succeeded in introducing by means of static electricity a germicide that will not affect the albumen of the blood, and has been proved to kill tubercle bacilli in lung tissues."

A dispatch from Cleveland, O., says the financial affairs of the Everett-Moore Syndicate, which went into the hands of a bankers' committee three years ago for liquidation, have been settled and the last creditor has been paid. The syndicate controlled a number of traction lines, electric light plants and telephone systems in and near Cleveland. The total amount of this firm's holdings reached into the millions.

Mr. Frank L. Perry, Marquette Building, Chicago, has been appointed assistant master of transportation, for Chicago and adjacent territory, with the particular duty of working up a special train from Chicago to Denver-Colorado Springs, which will be run in connection with a special train from New York for delegates to the National Electric Light Convention.

The economy from electric power in loading ships with grain, says the "Electrical Engineer," London, is illustrated by some tests lately carried out at Geelong, Australia. With three machines in operation for 8½ hours no less than 5,320 bags of wheat were handled on a current consumption of 42 kilowatt hours. At 5 cents per unit the work cost $2.10, a remarkably low figure for the quantity of material handled. It is estimated that a ship with a capacity of 20,000 bags of wheat can be loaded on this system for $8.75, while if the elevation to the ship's side were not too great to allow of two or three bags being placed on the belt, the cost of energy would be brought down to little more than half.

A PORTABLE WIRELESS TELEGRAPHY APPARATUS.

Some time ago the Gesellschaft fur Drahtlose Telegraphie in Germany brought out a portable wireless telegraphy installation which was made use of for reporting the James Gordon Bennett motor-car race. Since then, according to the "Electrician," London, progress has been made, especially in the direction of lightness of apparatus, and the latest wireless equipment may be carried from place to place by ten or eleven men.

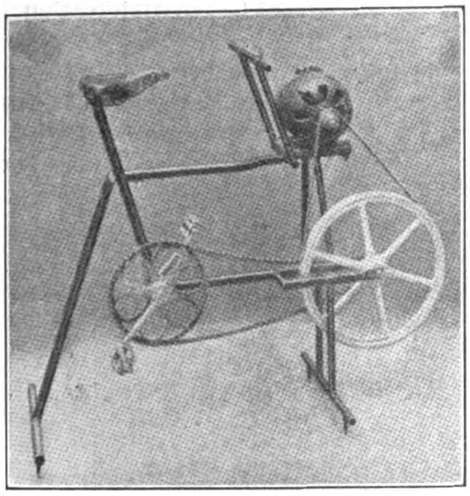


Fig. 1.
Treadle Arrangement for Generating Current for the Portable Wireless Telegraph Installation.

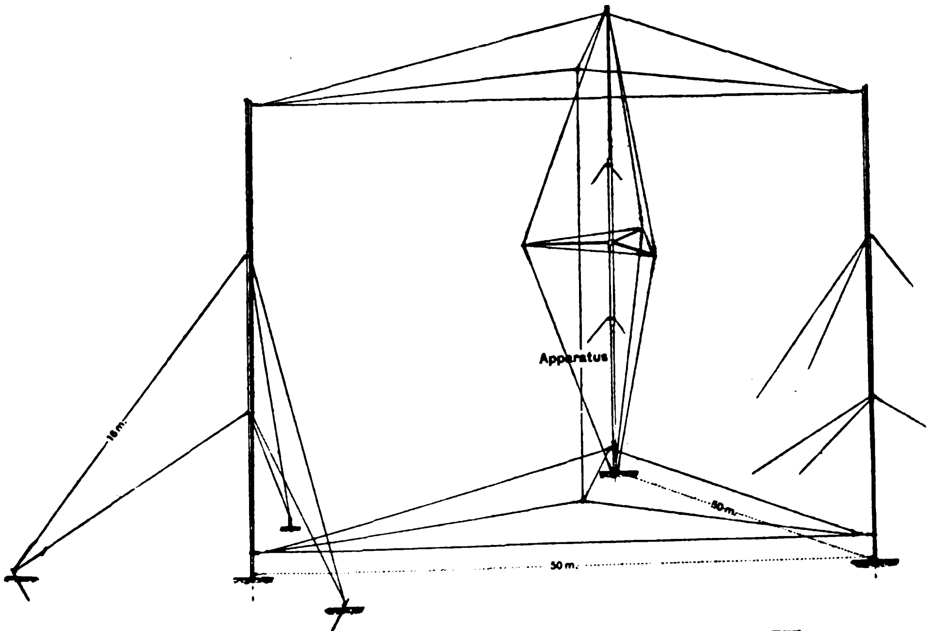


Fig. 2.—Arrangement of Aerial Wires of the Portable Wireless Telegraph Installation.

Ten men only are required when current is generated by a dynamo in the manner shown in Fig. 1, but eleven men are necessary if accumulators are used for supplying the current. The total equipment may also be loaded on three horses, the first horse carrying the masts, the second horse the transmitting and receiving instruments and the third horse either the dynamo or storage battery. Each piece of apparatus is placed in a bag of oilcloth for transport. The total net weight of a station is stated to amount to 445 lbs. when the dynamo is used and 510 lbs. when a storage battery is employed. Recent experiments, according to the company, have proved that a distance of about 15½ miles across flat country may be negotiated with three masts arranged as indicated in Fig. 2, each mast being 10 meters (31½ feet) high. The masts weigh 44½ lbs. apiece (including all tackle), this small weight being rendered possible by using steel tubes. When these are telescoped for transport their length is reduced to 12½ feet. The stability of the masts is increased by cast-iron base plates and suitable stays as shown in Fig. 2. Tinned copper cable, consisting of eight wires 0.4 mm. in diameter and supported by glass insulators is used for the aerial wire. The small continuous-current dynamo shown in Fig. 1 has an output of about 100 watts. It weighs, complete with driving arrangement, some 65 lbs. When the dynamo is not employed a 16-volt (8-cell) battery is used, having a capacity of about 30 ampere hours at a 5 hours' discharge rate. The accumulator cells are fitted in ebonite boxes, and these again are packed into two wooden boxes, each of which is 11½ inches high, 6¾ inches wide and 1 foot 1½ inches long and weighs about 65 lbs. The transmitter is also mounted in a wooden box, this box measuring 1 foot 9 inches by 9 inches by 1 foot, and weighing complete about 45 lbs. It contains, among other things, a Morse key, an inductor with hammer interrupter, a Leyden battery of six jars, the excitation coil tuned for a wave length of 400 meters (440 yards), a spark gap with zinc electrodes, etc. Even lighter is the receiving station which weighs only about 33 lbs. It consists of an electrolytic detector of the Schloemilch type, a pair of telephone receivers, a condenser, four dry cells, a contact box and so on. These apparatus are mounted in a box 1 foot 3¾ inches by 9¾ inches by 9¾ inches.

BIMETALLIC RHEOSTATS.*

BY F. PUNGA.

The choice of the proper material is one of the most important factors in the construction of rheostats; in fact, for starting rheostats where ventilation is of little importance, the problem is to directly store up a certain amount of heat in the cheapest way.

As the usual material for rheostats—wire of high specific resistance—is rather expensive, the attempt has been made to improve the heat-storing capacity by winding the wire directly on porcelain or on iron tubes, insulated by thin sheets of asbestos, or on asbestos tubes impregnated with special chemical substances and baked.

The inherent fault of all these arrangements is the sluggishness with which the heat is taken up by the surrounding materials.

Quite a different solution of the problem is the use of iron as resistance wire. This obviates the necessity for employing any other heat-storing materials, as iron is so cheap that a liberal quantity may be employed in the design.

This method has, however, a great lack of flexibility. Whilst very useful for currents up to 5 or 10 amperes, it is impracticable for larger currents to use one single wire, as the cross-section would be too large for bending, and one has to employ two or three, and often as many as six, different wires in parallel.

This leads to a series of disadvantages, especially if a good many steps are employed for the rheostat switch, as taps often have to be taken from the middle of a tube. If there are, say, six tubes in parallel, this means six taps for one rheostat step.

A solution, which is to a certain extent free from the faults of the above methods, has been devised by Mr. Hobart and the writer has helped in the development of this so-called "bimetallic rheostat." The chief material for storing up the heat is iron, but the current is conducted almost entirely by a copper winding which is in close metallic contact with the iron wire. The latter is able to absorb the heat from the copper very quickly; in fact, tests have shown that the copper winding can be designed quite independently of thermal considerations; the cross-section can be chosen so small that the wire would fuse instantaneously if suspended in free air.

---

*From the "Electrical Review," London.

The current density employed in a copper wire of 0.27 mm. was 250 amperes per sq. mm., or 150,000 amperes per square inch, and after 120 seconds the temperature of the wire was only just high enough to soften common solder.

By this means it is possible to obtain a rheostat in which the heating is taken care of by the iron wire and the exact resistance is obtained by choosing the copper of different cross-section. As the iron wire is preferably always of one and the same diameter, the copper cross-section being, however, very small, the general appearance of a rheostat for 15 amperes is about the same as one for 75 amperes.

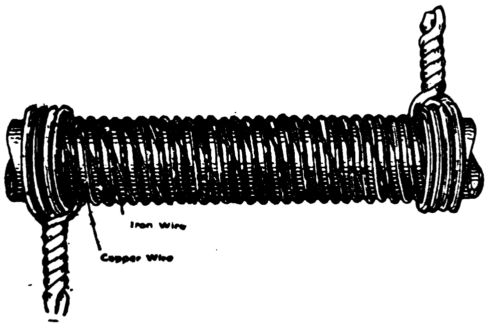


Fig. 1.

In the normal rheostats the iron wire is wound with about 6 turns per cm. length; the copper wire two or three in parallel, having only one-half turn per cm. length of tube. Iron wire and copper wire are in parallel, but as the former has a considerably greater length and considerably higher specific resistance only a small percentage—often from 5 to 15 per cent.—of the total current flows through the iron wire. This construction is shown in Fig. 1; the maximum current that can be conveniently carried in this way is about 100 or 150 amperes. Fig. 2 shows a tube for 125 amperes. It will be noticed that the greater the current the steeper becomes the pitch with which the copper wire is wound. For higher currents the construction in Fig. 3 is used which construction, in the form of honeycombs, can be used for almost any current.

The winding of the tubes shown in Figs. 4 and 5 has been done by hand, but, of course, to reduce labor cost, machine-wound rheostats would be employed in the factory, and suitable terminal caps would also be substituted for the twisted wires shown. The iron and copper wires can either be woven through each other in the manner familiar in covering copper wires with cotton insulation, or they could be wound in three stages: (1) One spiral of iron wire; (2) the copper winding; (3) a second spiral of iron winding between the turns of the first spiral.

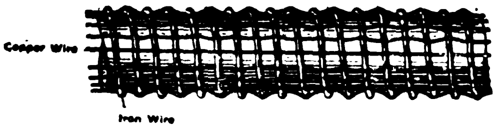
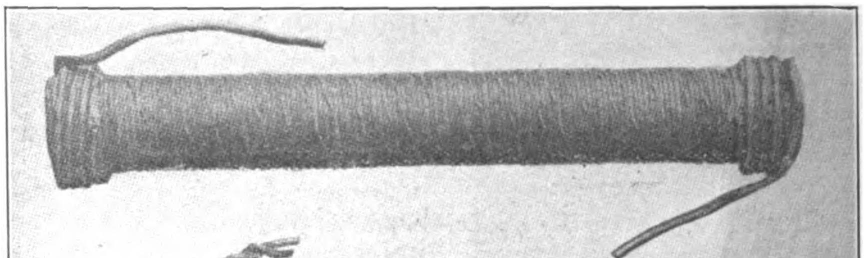


Fig. 2.

Fig. 4.



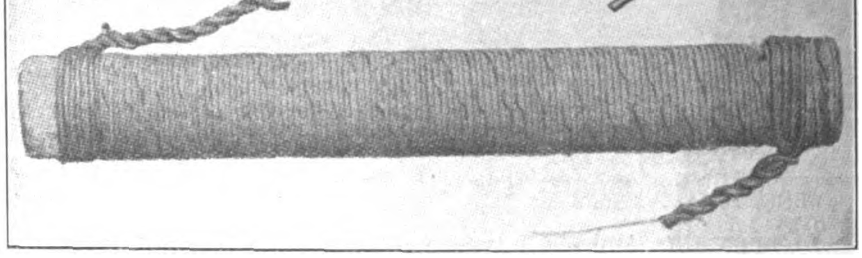


Fig. 5.

The winding itself is, however, not done for each tube separately, as is a necessary condition for the ordinary rheostats, but may be done in large quantities, 10 or 20 being wound in one continuous piece; terminals are wound round at suitable distances apart after the total length is wound and then single tubes are sawn out.

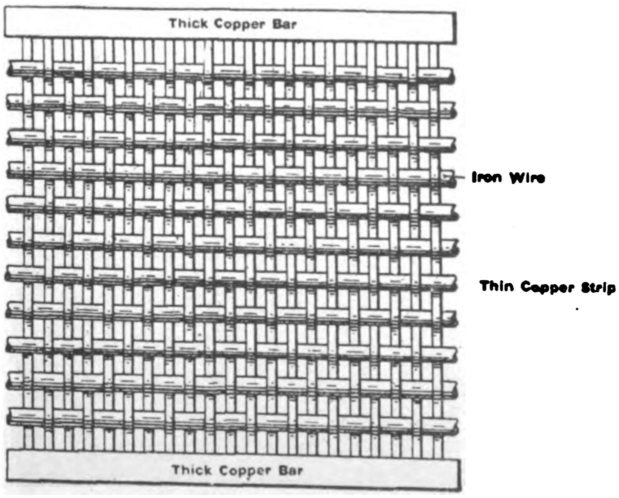


Fig. 3.

As there are generally no tubes in parallel, it is clear that the distance between two adjacent taps must be as many times larger as there are tubes in parallel for the ordinary construction; or, in other words, the length of a single tube can be chosen considerably larger than in the normal rheostats, and even then no taps from the middle of a tube will be necessary.

A Year's Work at the British National Physical Laboratory.

The following is a brief summary of the work accomplished at the British National Physical Laboratory at Bushy House, Teddington, during the past year:

In the physics department the work included among other things a comparison of the mercury standards of resistance constructed in the previous year, the investigation of certain anomalies in standard cells, of both the Clark and cadmium patterns, the construction of the electrical portions of the ampere balance for the British Association, and numerous tests of the dielectric resistance of different varieties of gutta-percha. Progress was made in equipping an electro-technical department to undertake the testing of electrical apparatus on a commercial scale, and electrical research work was carried out on behalf of the Engineering Standards Committee to determine the maximum temperature permissible in electrical machinery.

In the therometric department a considerable amount of new apparatus was installed and the work included the final stages of a research on the specific heat of iron at high temperatures and the beginning of a study of the resistance and thermo-electric properties of solid electrolytic conductors such as are used in Nernst lamps, with the view of designing a system of electrical high-temperature measurements based on some of the properties of zirconia, yttria, etc.

In the metallurgical department extensive tests were carried out on a series of nickel, carbon, and manganese iron alloys, prepared by Mr. Hadfield at the Hecla Works, Sheffield, and also an inquiry into the critical ranges on heating and cooling of modern high-speed tools.

In the photometrical department, intercomparisons were made by means of glow lamps with the National Standards Bureau, Washington, and the Electrical Testing Laboratories, New York, as well as with the Berlin Reichsanstalt, and further investigations are now being undertaken to determine the ratios between the standards of candle power accepted in America, Germany, France and Great Britain.

In the engineering department the standard leading screw lathe was fitted with a compensating bar to correct its errors and it is now true to within 0.0001 inch over the length of 36 inches. It has been used to cut a screw for Armstrong, Whitworth & Co., the errors in pitch of which, measured from one end, lie between — 0.0003 and + 0.0002 inch in a length of 36 inches. The effects of wind pressures on structures and the resistance of materials under alternating stresses have also been under investigation.

Much of this work is being continued during the present year, and among new researches proposed may be mentioned the influence of impurities on copper, the relation of carbon to iron in cast-iron, and the so-called constituents of quenched steels, the last being organized on an international basis.

* * *

PROVIDING FOR INCREASE OF POWER IN ISOLATED STATIONS.

ARTICLE V.—(*Concluded.*)

BY W. H. WAKEMAN.

The condenser has not been brought into these articles previously, as it may be applied to all engines mentioned with good results, therefore it belongs in the latter part of this series.

I have frequently objected to the statement which informs us that the addition of a condenser to a non-condensing engine makes it develop more power, for the simple reason that it is not correct. We are constantly seeking for devices and appliances that will cause our engines to develop less power and still do the work we want in every-day practice. This is a logical and business proposition, and when we add a condenser to a non-condensing engine the useless resistance to the piston of that engine is reduced, which is all that anybody can successfully claim for the change.

The following brief statement is presented for very careful consideration. The total load carried by an engine, as represented by a complete indicator diagram, may be divided into three parts as follows:

First—The part represented by the area of diagram.

Second—The resistance shown by the area of a space bounded on the top by the counter-pressure line (including the compression line) and on the bottom by the atmospheric line.

Third—The area of space bounded on top by the atmospheric line and on the bottom by a line representing a perfect vacuum under existing atmospheric conditions.

The first will remain the same after a condenser is added, although the shape of diagram will be changed. It is assumed that the same dynamos are operated and that neither voltage nor amperage are changed.

The addition of a condenser takes away the second altogether and it removes about three-quarters of the third, therefore it reduces the load shown by these two, forming a logical reason for the fact that when a condenser is added less coal is required. More power is not developed when considering the total load, but less.

Now if more dynamos are started, thus increasing the first item until it compensates for what is taken from the second and third, the result is that by adding a condenser and running more dynamos some of the useless work has been changed into useful work, and more electric lights can be furnished without increasing the coal consumption.

Fig. 7 illustrates an injector condenser as applied to this double engine, with a valve in each exhaust pipe, so that either can be shut off at pleasure. With the condenser in operation and both engines connected to it, also with enough more dynamos in use to keep the point of cut-off at one-sixth stroke, as assumed in a previous calculation, this engine will develop a mean effective pressure of 53

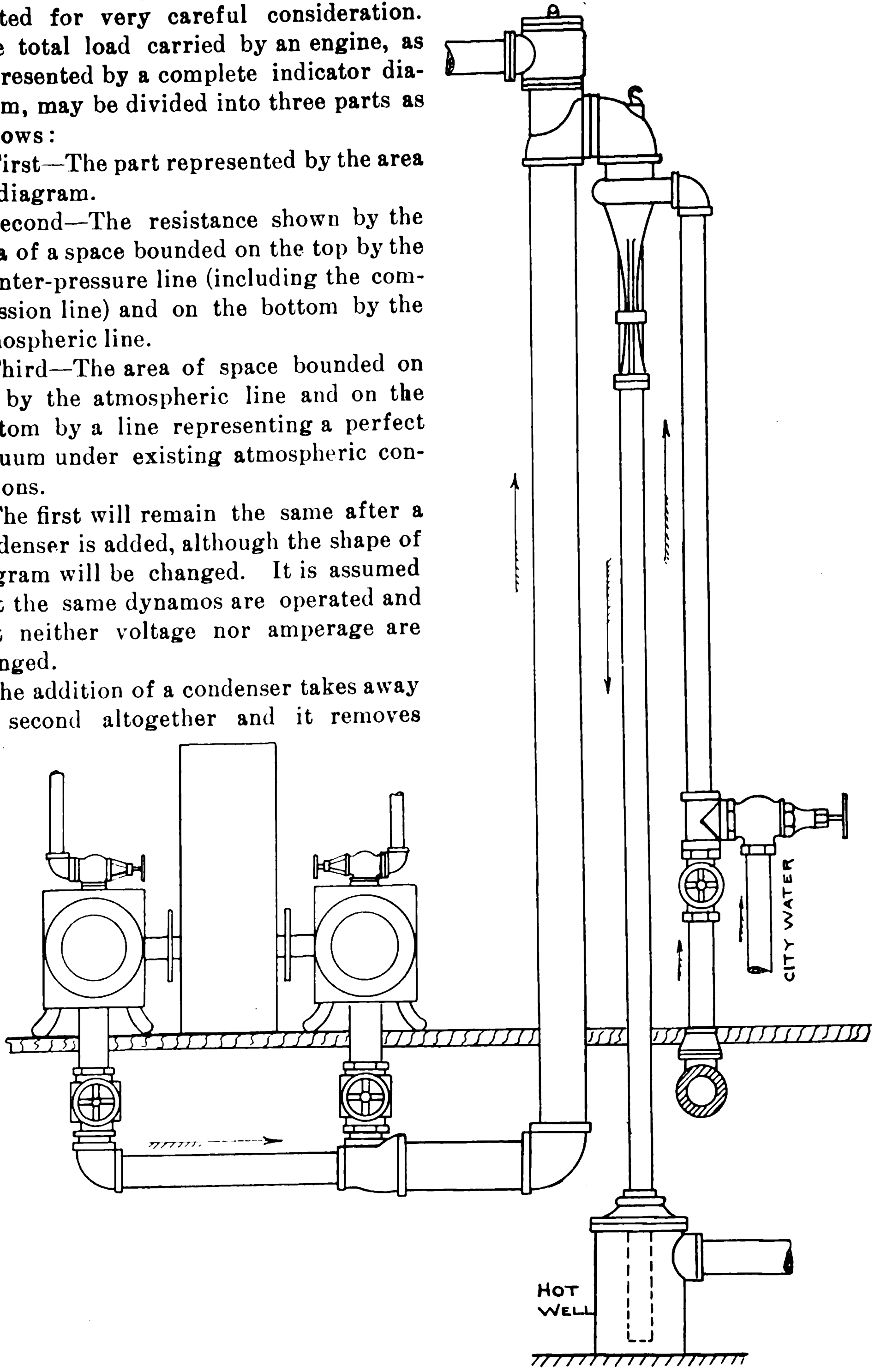


FIG. 7.

pounds, and as there are two cylinders it will develop power as follows:

$$\frac{314 \times 2 \times 53 \times 630}{33,000} = 635 \text{ hp.}$$

By advancing the cut-off to one-quarter stroke and assuming a back pressure of 3 pounds absolute the mean effective pressure is raised to 71.59 pounds and under these conditions (which are practical) the double condensing engine will develop 858 hp. This increase of power developed is due entirely to the addition of more dynamos or generators.

As the power in an electric station is usually stated in watts, which are reduced to kilowatts for convenience, as the prefix "kilo" means 1,000, an illustration of the calculation necessary to reduce horse power to kilowatts will not be out of place.

When calculating the power sent out, or developed by a dynamo, the amperes are multiplied by the volts and when the product is divided by 746 the quotient is the horse power developed, because 746 watts are equal to one electrical horse power. The term "electrical horse power" is used not because it differs from the steam horse power, for it does not, but as a matter of convenience when using it in connection with electricity.

As this engine is capable of developing 858 hp. it is equal to 858 × 746 = 640,068 watts, and dividing this by 1,000 shows that it amounts to 640 kilowatts.

However, this is on the basis of indicated horse power, and between the steam cylinders where pressure is secured and where dynamos send out current there is the friction of engine, shafting and dynamos. This will probably be not less than 20 per cent., or 640 × .20 = 128 kilowatts. Subtracting this from the total, shows that the actual output is reduced to 640 — 128 = 512, or, say, 500 kilowatts in round numbers. In other words, this engine is capable of driving ten generators of 50 kilowatts each, as shown in Fig. 5.

This load is too heavy for continuous service but it can be carried if required for a part of the night. As some of the lights are nearly always turned off about 10 o'clock in the evening, the reduction so secured will lighten the load enough to prevent heating of the machinery.

The Pennsylvania Tunnel.

(From the Philadelphia Ledger.)

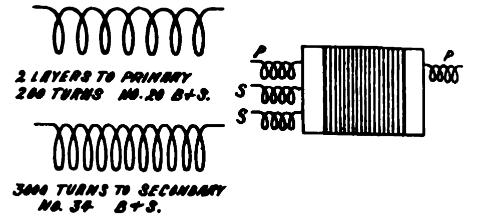
Among the interesting facts about the new Pennsylvania Railroad tunnel and terminal in New York are these: Total cost, $60,000,000, in addition to the $10,000,000 for the station site, on which were about 300 dwellings; daily train capacity, 900; passenger accommodation daily, 200,000; men at work, about 10,000; time required for trip under the Hudson, two minutes. In projecting this enterprise the engineers believe they have solved all the problems which baffled the most daring engineers of 23 years ago.

ELECTRICITY LEAFLETS.

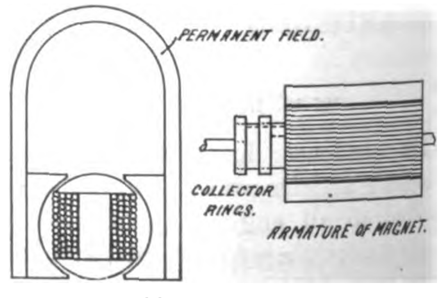
BY NEWTON HARRISON, E. E.

THE TELEPHONE.

The Induction Coil.—The success of a telephone system depends upon the employment of the induction coil, by means of which the pressure of the outgoing current is raised above that of the transmitter and its character changed into an undulating or alternating wave of electricity. The principle of its action is based upon the simple proposition of placing two coils in juxtaposition; one carrying the current which is directly employed, and the other the current resulting from this arrangement. Dr. Elisha Gray first introduced this idea in telephony, the object being to avoid the necessity of using a too powerful current in the transmitter and line. The transmitter, it is to be remembered, is used in series with a low pressure current, proceeding from either a primary battery or a dynamotor charging a storage battery. If the same current which is utilized for this purpose is also employed over the line then it would have to be capable of carrying that far. A current of this strength, and by this is meant both voltage and amperage, would be injurious to the transmitter and even then this would not possess the effectiveness of one produced by means of an induction coil. The current passing through a transmitter is always of one direction, simply varying slightly in strength with the variations in pressure in the transmitter. The current which will prove most satisfactory in a receiver is an alternating current. Therefore the transmitter current in the original form absolutely requires modification. To effect this modification of a unidirectional current into an alterating current at one time threatened to be a very difficult problem, but the introduction of the induction coil was the means of easily and inexpensively bringing about the transformation. The current entering the transmitter also passes through a coil of wire consisting of about 200 turns of No. 20 B. & S. gauge wound in two layers before completing its circuit. Around this first or primary coil is wound another or secondary coil which in its turn consists of about 1,500 turns of No. 34 wire wound in a double layer, that is, two wires side by side. This winding is therefore about 3,000 turns in all when they are connected in series or 1,500 double turns in multiple. The result of this juxtaposition, as previously stated, of the windings, is to raise the electromotive force of the current higher in proportion to the ratio of the windings. If the primary coil has 200 turns and the secondary 3,000 turns, then the ratio would be 3,000 to 200 or 15 times the pressure in the secondary as compared with the primary current. The changes in the transmitter are correspondingly magnified, with the result that the general effectiveness of the system is enhanced to an extraordinary degree.



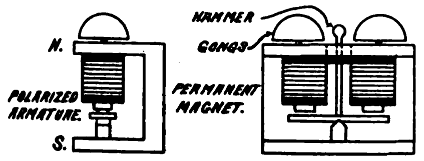
THE INDUCTION COIL.



THE MAGNETO.

The Magneto Generator.—Although the telephone system in Greater New York dispenses with the necessity of employing a magneto for ringing up a subscriber still the magneto call bell is required for signaling from the exchange itself to a subscriber. The subscriber, let it be understood, by this method signals "central" by merely lifting the receiver off the switchhook, though "central" signals by ringing the subscribers' bells. The employment of the magneto-generator has been the means of saving an enormous amount of possible trouble in the development of the signaling end of the telephone system in general use. A magneto generator is a dynamo having an armature wound with many turns of fine wire which produces and delivers an alternating current, and is in addition provided with fields or magnets which are "permanent." Thus the construction is as follows: A field of steel magnets, and a shuttle armature of soft iron wound with many turns of fine wire and collector rings or their equivalent for the conduction of the current. These devices are constructed so as to ring through 1,000, 5,000, 10,000 or even 50,000 ohms of resistance. It is therefore easy to estimate the value of this machine; of such simple and cheap construction; always ready to produce an alternating electric current with a few turns of the handle and able to ring through high resistances with comparative ease. The current when entering a call bell used in signaling is the means of causing a systematic tingle of a very vigorous character. This illustrates the difference between the generator and the call bell attachment, though both are generally found together in the so-called magnetos for telephone service.

The Call Bell.—The peculiarity of this device lies in the fact of its being partly magnetized. The armature and cores are so situated with respect to each other that when an alternating current passes through the coils of the magnets the armature is attracted and repelled and the bell hammer thereby strikes the two small gongs violently back and forth. The attraction and repulsion are the result of a permanent magnet being utilized to act both as a support for the magnet cores and a pivot for the armature. The two cores are thus magnetized by one pole and the swinging armature by the other. It is a simple matter to realize that an alternating current will be the means, by magnetizing these cores through their windings, to alternately weaken and strengthen their polarities respectively, of causing the armature to oscillate rapidly and thus to ring the bells by the hammer attached to it. Each of these devices represent more than they appear to be at first glance. It cannot be said that any one man was capable of originating and perfecting telephony to its present stage of excellence. On the contrary, each piece of mechanism was in some respects almost the life study of a group of scientists and inventors, their co-operation as it were being the foundation of all present successes.



Call Bell Construction.

Parts of a Telephone System.—A telephone system, theoretically, consists of a very simple combination of parts; a receiver at each end and a connecting line, but in practice more than this is required. Among a few of the important adjuncts, some of which have been noted, may be mentioned—

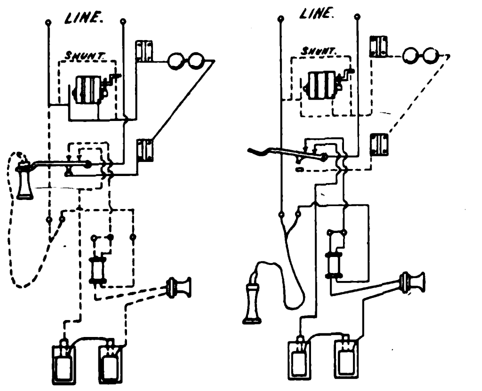
For transmission—the induction coil.

For speaking—the battery and the transmitter.

For hearing—the receiver.

For signaling—The call bell and the magneto.

The device, which represents only a connecting link between the two important parts of a telephone system, namely, the speaking and signaling circuits, is called the switch hook or hook switch. This is an automatic device by means of which the receiver when in use cuts out the signaling circuits and when not in use, by resting on the hook, throws them into circuit again. This idea is well represented in the illustration where the working plan is shown. The final resting place of the switch downward through the weight of the receiver cuts out the speaking circuit, composed of the battery, transmitter and primary of the induction coil. When the receiver is removed the switch hook cuts out the circuit composing the magneto and call bell; this, as is well known, being only done when the transmitter is to be employed and the receiver is held against the ear.



Station Circuits, Showing Switchhook.

Shunting the Magneto.—If the current entering the subscriber's call bell from a distance had to traverse the winding of the magneto armature, it would be weakened to a point that would probably render it useless. To avoid this difficulty a shunt or side path for the current is supplied wherever a hand magneto is used for signaling. This, in one of its simplest forms, consists of a round box-like device attached to the shaft. It is partly filled with small pieces of metal which are normally at rest, as shown, and thus provide a path for the incoming current which cuts out the magneto. When the magneto-handle is turned, however, the small metal pieces fly away through centrifugal force and break the shunt circuit otherwise formed by their being at rest. When they are at rest, the armature is, so to speak, short-circuited by them; when they are thrown against the sides of the box, the magneto is restored to its normal condition, and may be used for signaling.

Telephone Systems.—The telephone systems in vogue may be classified in various ways. Perhaps the most practical would be that of separating them into three general divisions as follows:

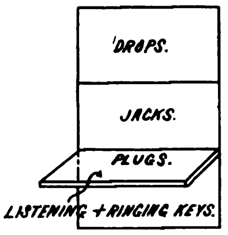
First—The party line and intercommunicating system.

Second—The central station, central exchange system.

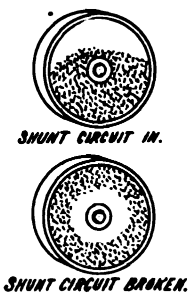
Third—The automatic central station system, or automatic exchange.

The intercommunicating system is of great service where the number of telephones is not too great. It finds its best application in hotels, factories and houses employing many 'phones. By this system of telephoning, any one in the system may be reached and spoken to readily, and is generally accomplished by means of a specially constructed switch. The party line or common circuit system is open to objections, among which the chief one might be regarded as lack of privacy. The central station system is by far the most important, and therefore calls for first consideration in the art of telephony.

The Central Station and its Switchboard.—Where more than 20 or 30 subscribers are dependent upon a telephone system for the purpose of exchanging remarks for business or social purposes, any other than a switchboard system, or at least a system employing a switchboard is out of the question. The central station or "exchange" system like everything else exists because it is the fittest to survive in the inventive and competitive struggle for first place. In barest detail it consists of a switchboard so equipped that two subscribers may be readily placed in communication with each other when one "rings up" and asks for the other. This apparently simple process is accomplished by means of a switchboard whose devices are adapted to this purpose and may be classified under the following heads:



Principle of the Telephone Switchhook.



Magneto Shunt.

1. For notifying "central"—Drops are employed.

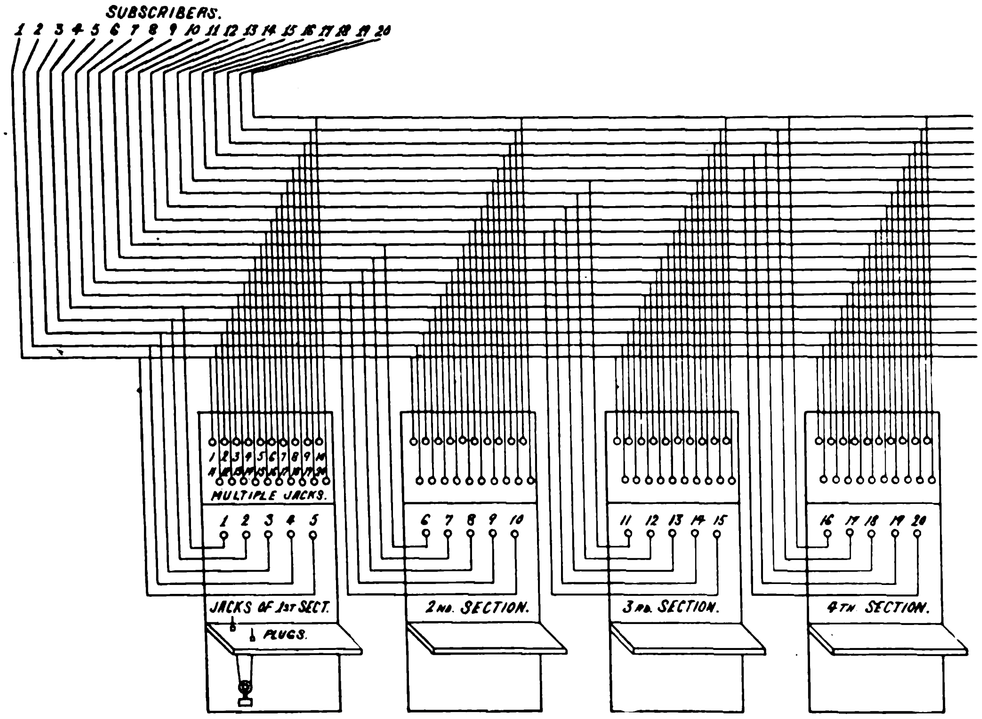
2. For connecting subscribers—Spring jacks are in use.

3. For line terminals of subscribers—Plugs with flexible cords are in service.

4. For listening and ringing up subscribers—Keys or switches are used.

The switchboard is so constructed that the operator or "central" can readily see and manipulate at the same time. The drops occupy the upper portion of the switchboard, as shown, and may run up in numbers corresponding to the number of subscribers' wires. Beneath these drops are the spring jacks, then on the horizontal portion of the switchboard are the plugs and keys, as indicated.

The Multiple Switchboard—The switchboards in use for city subscribers are necessarily very large and complicated. The smaller switchboard, serviceable for 50, 100, 200 or 300 subscribers, would not be great enough to cope with subscribers running into the thousands. Confusion and consequent delay would be the certain cause of failure in telephone service if allowed to exist. The operators are therefore given a certain number of subscribers apiece to take care of, with the means as well, in the switchboard construction, of connecting them to any other subscriber who is attached to the same board. Thus the labor is subdivided without any resulting delay or confusion, and each operator only takes care of 100 or 200 subscribers.



PRINCIPLE OF THE MULTIPLE SWITCHBOARD.

Principle of the Multiple Switchboard.—If a number of small switchboards were employed, and an operator with such a switchboard desired to connect a subscriber to another on a switchboard at the other end of the room, difficulty would naturally result of a most disagreeable character. To obviate this the subscribers are grouped into sections, and their lines brought to one large multiple switchboard, in which not only are the subscribers' lines in each section of easy access to the operator, but the connection permits the operators to connect the subscribers of the section in their individual charge to any other on the switchboard. This idea is shown in principle in the illustration where the employment of local jacks simplifies the proposition. Here the jacks of all subscribers on the multiple board are found in each section of the board. Each operator can therefore connect a subscriber with the utmost readiness with whosoever they may desire. In a multiple board, consisting of 4 sections of 5 subscribers apiece, if the operator in charge of section No. 1 ranges from 1 to 5, and No. 2 from 6 to 10, then they can manipulate as follows:

Operator No. 1 from 1 to 5, and to anyone from 1 to 20.

Operator No. 2 from 6 to 10 and to anyone from 1 to 20.

Operator No. 3 from 11 to 15, and to anyone from 1 to 20.

Operator No. 4 from 16 to 20, and to anyone from 1 to 20.

Following the diagram will clearly show the meaning of this important principle in multiple switchboards.

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Manila's Electric System.

The horse car system has been abolished in Manila and last week an up-to-date electric system was put in operation. Owing to climatic conditions, all the rails were painted with asphaltum. The destructive "white ant" exists in such large numbers that it was necessary to use teak for ties and sleepers. The rolling stock consists of 100 cars especially designed. The power plant is on an island in the center of the Pasig River and has a generating power sufficient to supply 500 arc lights, 30,000 incandescents, and current necessary for operating 100 cars over 40 miles of track.

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ENGLISH ELECTRICAL NOTES.

(From our London Correspondent.)

Electricity in Mines and Collieries.

During the past six months and more English electrical engineers, more particularly those who have specialized in the direction of mining installation work, have been very closely following the discussions which have been centering around the new Government rules and regulations relating to the equipment and operation of electric light and power plants in mines. The original draft was placed before colliery authorities and others for their comment and criticism with a view where necessary to emendations being effected before they came into force. We understand that the conditions are now about to come into operation, and in some quarters the view is expressed that they will lead to greater progress in English electric mining applications because they will make far safer and more efficient working. One inevitable result of the recent Governmental attention to the subject has been the further awakening of the English colliery owner and manager to the advantages accruing from electrical working under most conditions. There are distinct signs of important development just now. Much prejudice against electricity has been cleared away.

Quite naturally the new regulations have been the subject of discussions and papers at some of the provincial sections of the Institution of Electrical Engineers, and also at meetings of mining and engineering societies. Several of the papers prepared for these occasions by experts, have given much information relating to work done in different countries and the satisfactory economical results obtained. Practical data thus recorded have served the two-fold purpose of educating electrical engineers and convincing and converting mining officials. On March 28 a useful paper was read at Manchester by Mr. M. B. Mountain, M.I.E.E. Some mention was made of the work accomplished in the British Colonies, and in this connection, perhaps one of the finest installations in the world is that operating at the De Beers and Kimberley Mines.

At De Beers electrical working is used almost exclusively, and the installation is continually extending. The plant in 1903 had an output of 4,000 hp. steam turbines coupled direct to alternators being in use. Current is generated at 5,000 volts and distributed throughout the mines for working all classes of machinery and for hauling trains of trucks. Tables of performances of different types of coal cutting machines were among the statistical data prepared by Mr. Mountain.

Electrical Properties of Radio-active Substances.

Prof. J. J. Thomson has just concluded a series of three most interesting lectures on this subject before the Royal Institution in London. The chief conspicuous property of these substances was shown to be that of making the air around them a conductor of electricity. The behavior of a gas that was being ionized at a definite rate was described, it being pointed out that the number of electrified particles cannot increase indefinitely because destruction proceeds simultaneously with production, in consequence of the union of positively and negatively electrified particles to form non-electrified wholes. The saturation current was declared to be extremely important in the study of radio-active substances, because it represents a perfectly definite quantity and its measurement constitutes the most delicate method of detecting a radio-active substance. Prof. Thomson described the different kinds of radiation given out by radio-active bodies and said that the rays most recently detected were distinguished by want of penetrating power; they could only get through a few millimeters of air at ordinary pressures, whereas some of the other rays, which were unaffected by the strongest magnetic and electric fields, and were analogous to the Roentgen rays, could pass through six inches of solid lead. The new rays were detected by Prof. Thomson while he was trying to collect the electricity of the a rays which have been known for some time and which were positively charged and in mass were equal to nearly twice the hydrogen atom. It was found, said Prof. Thomson, that in an apparatus which should have indicated the presence of positive electricity, negative electricity was abundant; the cause of this was traced down to the fact that the radio-active body employed in his experiment was pouring out an immense stream of particles which were negatively charged but comparatively slow moving. Thorium and radium in particular are always giving off radio-active gas. In the case of thorium the gas rapidly loses its activity, the activity diminishing by one-half in the course of a minute, but radium takes four days to fall to half its value. The celebrated lecturer remarked that though radium was so very costly it seemed to be one of the most common elements. He had traced it in Cambridge tap water, in wheaten flour and so on. A radium atom he said lived for 800 years.

Among the many interesting things said by Prof. Thomson in the course of his entrancing lectures, was one relating to the stage at which radium showed its peculiar properties. These, he said, were only apparent at the end of its career, after persisting unchanged for centuries. This, he is reported to have said, "was a warning against assuming too hastily that because a phenomenon, such as the rising of the sun, had happened an indefinite number of times in the past, it was therefore going to continue indefinitely in the future. A spinning top might be made big enough to maintain its stability for days, but there came a time when a critical value was reached below which equilibrium could not persist. The case of radium was analogous."

THE FLEMING CYMOMETER.

The London Physical Society has recently had the pleasure of listening to Prof. J. A. Fleming, F.R.S., read a paper on the application of the cymometer to the "Measurement of Co-efficiencies of Coupling of Oscillation Transformers." The cymometer is an invention of Prof. Fleming's, by means of which the frequency of electrical oscillations can be measured as well as the length of electric waves. The present method is largely one of calculation; by means of which the number of oscillations per second, such as would proceed from a condenser for instance, are obtained from a knowledge of the values of the resistance, self-induction and capacity of the condenser and its circuits. When the number of oscillations per second are obtained, and they may range from one million to many millions per second, the length of a wave is obtained by dividing the speed of light, 192,000 miles per second by the number of oscillations in the same period of time.

For instance, if calculation shows that 192,000 waves are projected by a static discharge per second, the length of each wave would equal 192,000 miles divided by 192,000 waves, giving one mile as the length of each wave.

The cymometer consists of a sliding tubular condenser having two brass tubes separated by a thin ebonite tube, the outer tube capable of sliding off the inner tube. Parallel with this sliding condenser is placed an inductance coil or helix of bare copper wire wound on an ebonite tube. The outer brass tube of the sliding condenser carries a collar, which in turn carries a rod with a crutch at the end resting upon the inductance coil. The circuit of the instrument is completed by a copper bar, which joins one end of the inductance coil with the inner surface of the sliding condenser. When the outer tube of the condenser is moved by an insulating handle, the same motion reduces equally the capacity of the condenser and the position of the inductance coil included in the closed circuit. The circuit therefore consists of a variable capacity and inductance in series.

Prof. Fleming calls the square root of the product of the capacity and inductance in any position, the oscillation constant of the instrument. A scale is provided parallel with the inductance coil on which is engraved the oscillation constant and the corresponding frequencies. The formula generally given for a particular self-induction and capacity is that the frequency in waves thus resulting is equal to 1 ÷ (2 × 3.1416 × the square root of the product of the capacity and inductance.) The cymometer is also provided with a vacuum tube, preferably a Neon vacuum, which is connected between the inner and outer surfaces of the condenser.

The copper bar is placed parallel and near to a circuit in which oscillations are taking place and the handle of the instrument is moved, thus varying the oscillation constant, until the vacuum tube glows most brightly. Under these circumstances, it is known that the circuit of the cymometer is in resonance with that of the circuit being tested and their oscillation constants are therefore the same, hence the scale reading gives the product of the capacity and inductance of the circuit being tested. The instrument is also provided with a rectangular wire circuit the inductance of which is known. If this circuit is joined up with any unknown capacity and oscillations set up in it, the cymometer can be used as above, to determine the product of capacity and inductance in the circuit being tested, and the inductance being known, the capacity is therefore known also. Again, if we have any oscillation transformer, we can join up the primary and secondary circuits so as to inductively oppose or aid one another.

The inductance of any circuit can be

obtained for the high frequency currents by the cymometer in the following manner: The circuit to be tested is joined up in series with a known capacity and the rectangular circuit provided with the instrument. Two measurements are then made—first, when the inductance to be tested is included in the circuit; and second, when excluded from it. If the oscillation constants in both these cases are obtained, then the inductance will be equal to the oscillation constant of the first test minus the oscillation constant of the second test divided by the capacity, or

$$\text{Inductance} = \frac{\text{1st oscillation constant} - \text{2d oscillation constant}}{\text{capacity}}$$

The cymometer is particularly applicable to the measurement of the oscillation constant of a wireless telegraph aerial. The frequency in an open oscillating circuit and the length of ether wave resulting would be a valuable accomplishment from a direct practical standpoint. The frequency and length of wave received at a distant receiving point would also add greatly to knowledge required on the subject if measured, as claimed, with sufficient accuracy.

As regards the coefficient of coupling and the respective energies of the two rates of oscillation Prof. Fleming said he had not given sufficient attention to the theoretical side of the subject to be able to furnish expressions for the energies of the two oscillations.

In connection with wireless telegraphy and the antennæ or aerial employed, Prof. Fleming stated that if the mutual induction between the aerial wire and the cymometer were small, as it was in the case of the instrument exhibited, then the cymometer only detected the oscillations which existed in the aerial. There was no creation of duplicate oscillations in and by the cymometer itself.

The change in the dielectric capacity of such insulating materials as rubber and glass were discussed by Prof. Fleming in answer to a question asked; and he stated that rubber or ebonite was chosen in place of glass because in this material the change in this respect could not be detected with varying frequencies.

In glass the strange fact is presented, that under the varying stress of frequency the dielectric quality of it changes. To remove such possibilities in his apparatus, the only material reliable enough to give the element of accuracy required was ebonite. Thus the general nature of the application of Prof. Fleming's device as thus reviewed, is that of readily discovering the frequency and length of long electric waves. This is possible by means of an inductance and capacity that is adjustable. When adjusted and a certain degree of resonance is established the little Neon tube will glow. By this indication it is known that the circuit undergoing examination, and the cymometer are in tune electrically with each other. The immense advantage obtained by this device by those experimenting in the field of wireless telegraphy and telephony or to those conducting scientific experiments can very well be imagined.

With a definite knowledge of frequency and wave length during all experiments and tests, it seems that the striving after syntonic telegraphy will rapidly approach a successful issue. Sympathetic systems, which, unless awakened to action and response by a certain frequency, are inoperative, and thereby preserve the privacy so necessary to practical success, will now be tuned with accuracy. The cymometer is thus of peculiar value at this particular period in the development of wireless methods as in all probability time will so readily testify.

The Magnetic Club Dinner.

The Magnetic Club held its annual spring dinner on Thursday evening last, in the ballroom of the Hotel Astor of this city. Seated at the table with Col. A. B. Chandler, president of the club, were Thomas A. Edison, Clarence H. Mackay, Col. Robert C. Clowry, P. V. De Graw, Frederick P. Fish, U. N. Bethell and Patrick J. Murphy.

Never before, it was remarked, had the men practically in control of the electrical communications over the larger part of this continent and under the seas West and East met on an occasion of like character, and in this respect at least, the dinner was unique, attended as it was by about 220 of the most prominent and active telegraphers and other workers in the local electrical field. Although the Magnetic Club has four dinners a year, the spring dinner is the eventful one of the four.

When Colonel Chandler introduced the after-dinner period with a brief speech he was greeted at intervals with the clicking of telegraph instruments, the sound of the phonograph and the ringing of telephone bells.

If Mr. Edison, who had sat immobile on the right of Colonel Chandler, never before had been stirred from his well known passiveness, he plainly showed himself moved at the interpolations which had been carefully prearranged. When Colonel Chandler referred to the telegraph the company, led by a pianist and soloist, sang to the air of "My Grandfather's Clock" an original verse and chorus.

The dramatic event of the night was in connection with Colonel Chandler's comment on the electric light. Then the electric lights in the banquet hall were switched off and in the mellow glow of shaded light from the banquet candles the company sang "It Was Just Like This in the Olden Days." When the current was switched on and the diners arose and cheered Mr. Edison to the echo he, too, stood and bowed, the applause continuing after the famous inventor resumed his seat.

Other speakers, who were entirely informal in their remarks, no toast programme having been arranged, were Mr. De Graw, Mr. Fish, Mr. Van Wormer, Mr. Estabrook and Mr. Murphy.

Bids Wanted for Government Electrical Supplies.

The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until May 2 for furnishing Eastern navy yards with the following material: Schedule 161, panel boards, cable, wire, electrical supplies; schedule 162, cable, annunciators; schedule 164, cable; schedule 165, electrical supplies. Blank proposals will be furnished on application to the Navy Pay Office in New York or to the Bureau. Applicants should designate by number the schedules desired.

On May 9 the Bureau will open bids for furnishing the Naval Home in Philadelphia with electrical supplies during the next fiscal year. Blank proposals may be obtained on application to the Navy Pay Office in Philadelphia or to the Bureau of Supplies in Washington. The schedule number is 168.

The War Department, through the Signal Office, is inviting sealed proposals until May 11 for furnishing the Signal Corps with 10-drop telephone switchboards, according to specification No. 282, in lots of 10 and 20. Prices to hold good until June 30, 1906. Further information will be furnished on application to Gen. A. W. Greely, chief signal officer, Washington, D. C.

The Secretary of Agriculture is inviting sealed proposals until May 10 for furnishing and laying for the Weather Bureau 35 statute miles of one-conductor telegraph cable between Charlevoix and Beaver Island, Mich. Blanks and information for bidding may be obtained from the Chief of Weather Bureau, Washington, D. C.

Col. Charles S. Bromwell, in charge of

public buildings and grounds, Washington, D. C., is inviting sealed proposals until May 10 for furnishing electric battery supplies during the next fiscal year.

American Institute of Electrical Engineers.

The annual business meeting of the American Institute of Electrical Engineers will be held in New York City, Tuesday, May 16, at which the reports of the board of directors and the treasurer will be presented.

A Bargain in Motors.

Our readers are requested to take notice that a great bargain sale in motors will be held by Charles Shongood on April 26, 1905, at 10:30 A.M., at 113 Leonard street, New York City. These machines are of exceptional quality and are adapted to small power purposes and sewing machine service. The number of complete motors is 250 and in addition about 250 fields and many armatures will be sold. Business misfortunes on the part of the manufacturer have led to this opportunity. In addition to the above, several hundred electric sewing machine stands complete and others unassembled will be sold. The property may be inspected at any time before the sale and further particulars can be had on application.

A New Electric Clutch.

The Williams Electric Machine Company, of Akron, O., has recently brought out a new and improved electro-magnetic clutch, the invention of Mr. H. A. Williams. This clutch is the result of years of experimenting and is fully covered by 18 United States patents. The clutch is of the friction disk type, one-half of the disks being mounted on the driving, and one-half on the driven. These disks are interleaved and are a part of the magnetic circuit. When the current is thrown on the magnetic coil the moving member of the clutch compresses the disk which by their friction one with the other, take up the load similar to the operation of the well known mechanically operated fric-disk clutch that have long been on the market and which have been a decided success. A catalogue descriptive of this clutch may be had by addressing the company as above.

Entertaining and Interesting Publicity.

The New York Central's "Four-Track Series" has for 15 years been a recognized feature in railway advertising, and one which has been made so general as to include, directly or indirectly, scores of industrial and other American enterprises which are of interest not only to all citizens of this republic but also command the attention of our British and European cousins, and our brothers and cousins in the Far East. No. 38 of the "Four-Track Series" has just been issued and is a comprehensive presentation of the general information bureaus and city ticket offices of the New York Central lines in America and in Europe. It is beautifully printed and contains 82 illustrations. A copy will be sent, postpaid, on receipt of a two-cent stamp, by George H. Daniels, General Passenger Agent, New York Central Railroad, Grand Central Station, New York.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED APRIL 11, 1905.

Electric Railways and Appliances.

786,795. Trolley-Wheel. Edwin W. Clark, Columbus, Ga. Filed July 28, 1904.

786,832. Trolley-Wire Guide. Stewart P. McMullen, Sioux City, Ia. Filed June 4, 1904.

786,887. Trolley Device. Anton F. Flierboom, Elizabeth, N. J., assignor of one-half to John F. Conrad and William R. Bonnell, same place. Filed Jan. 28, 1905.

786,894. Railway Signal. Orlando W. Hart, Fall River, Mass. Filed Aug. 14, 1901.

787,033-034-035-036. Trolley-Stand. Boniface A. Grasberger, Richmond, Va. Original application filed Jan. 23, 1904. Last application filed Jan. 20, 1905.

787,169. Trolley Catcher and Retriever. Charles E. Gierding, Newark, N. J. Filed July 7, 1904.

787,343. Wire-Replacer for Trolleys. William Peck, Steubenville, O., assignor of one-half to W. W. Harper, Toronto, O. Filed Dec. 13, 1904.

Electric Lights and Appliances

787,043. Electric-Arc Lamp. Bruno Jackisch, Charlottenburg, Germany, assignor to the firm of Allgemeine Beleuchtungs und Heiz Industrie Actien Gesellschaft, Berlin, Germany. Filed Sept. 23, 1904.

787,338. Rosette or Receptacle for Conduits for Electric Wires. George A. Lutz, New York City, assignor, by mesne assignments, of one-half to Frank K. Boland, same place. Filed May 23, 1901. Renewed June 5, 1903.

Electrical Machinery and Apparatus

786,797. Electrical Stop-Motion. George B. Cocker, Frankford, Pa. Filed Nov. 20, 1903.

786,823. Electricity-Meter. Friedrich Lux, Heidelberg, Germany. Filed Nov. 29, 1902.

786,907. Electric Time Relay-Switch. William W. Lackie, William T. Calderwood and William H. D. MacEwen, Glasgow, Scotland. Filed April 26, 1904.

786,918. Continuous-Current Electric Motor. Henri Pecheur, Paris, France, assignor to the Societe Anonyme pour le Travail Electrique des Metaux, same place. Filed Jan. 6, 1905.

786,939. Transmission Gear. Gilbert R. Albaugh, Cleveland, O., assignor, by mesne assignments, to the Olds Motor Works, Detroit, Mich. Filed Dec. 15, 1902.

786,955. Emergency Brake-Valve. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 15, 1904.

787,027. Monophase and Polyphase Alternating-Current Machine. Michael von Dolivo-Dobrowolsky, Berlin, Germany. Filed May 18, 1903.

787,096. Power-Transmission for Motor-Vehicles. Stephen H. Hanson, Akron, O. Filed May 10, 1904.

787,147. Lock for Electric Switches. Charles L Buschmann, Indianapolis, Ind. Filed Feb. 20, 1903.

787,184. Dynamo. Edward B. Jacobson, Pittsfield, Mass., assignor to the Pittsfield Spark Coil Company. Filed Jan. 27, 1904.

787,187. Electric Time-Switch. Robert D. Jones, San Antonio, Tex. Filed Oct. 1, 1903.

787,227. Electric-Motor System. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company. Filed Oct. 5, 1903.

787,256. Direct-Current Meter. James S. Anthony, New York City, assignor to the General Electric Company. Filed Aug. 15, 1902.

787,292. Dynamo-Electric Machine. Tracy B. Hatch, Los Angeles, Cal. Filed March 7, 1904.

787,303. Alternating-Current Series Motor. Marius C. A. Latour, Paris, France, assignor to the General Electric Company. Filed Aug. 30, 1904.

787,305 Alternating-Current Motor. Maurice Milch, Schenectady, N. Y., assignor to the General Electric Company. Filed Oct. 12, 1903.

787,336. Method of Operating Alternating-Current Motors. Waldo A. Layman, St. Louis, Mo. Original application filed Dec. 28, 1903. Divided and this application filed Sept. 3, 1904.

Telephones and Telephone Apparatus

786,901. Telephone-Exchange System. John C. Hubinger, Keokuk, Ia. Filed April 18, 1904.

786,925. Means for Signaling and Telephoning on Electric-Trolley or Other Systems. Charles R. Van Trump, Wilmington, Del. Filed Aug. 4, 1904.

787,107. Telegraph or Telephone Wire Insulator. Robert J. McDaniel and Salathiel V. Graves, McFall, Mo., assignors to Samuel I. Hudson, Watkins Mo. Filed Dec. 10, 1903.

787,113. Apparatus for Telephone-Exchange Systems. John G. Roberts, Chicago, Ill., assignor to the Western Electric Company. Filed Jan. 18, 1904

787,119. Desk-Telephone Bracket. Thomas Q. Scott, Baltimore, Md. Filed May 14, 1904.

787,120. Trunk-Line for Telephone-Exchanges. Charles E. Scribner, Chicago, and Frank R. McBerty, Downers Grove, Ill., assignors to the Western Electric Company. Filed April 23 1897.

787,307. Jointed Adjustable Support for Telephone Receivers. Edwin D. McLean, Marissa, Ill., assignor of one-fourth to William W. McLean, Pittsburg, Pa., and one fourth to Edward S. McLean and one-fourth to James M. McLean, Marissa, Ill. Filed Jan. 9, 1904.

Miscellaneous.

786,843. Electric Signaling System. William F. Robinson and Columbus F. Broadhurst, Kansas City, Mo. Filed Oct. 3, 1903.

786,111. Electric-Conduit Terminal. William J. Miles and Jesse Patterson, Buffalo, N. Y. Filed June 21, 1904.

786,912. Burglar Alarm. Charles O. Miller, Estherville, Ia., assignor to the Millers Electro-Pneumatic Burglar Alarm Company, same place. Filed April 9, 1903.

786,946. Means for Recovering Magnetic Iron from Ore-Seperating Tanks. Erastus S. Bennett, New York City. Filed Oct. 17, 1903.

787,005. Electric Recording Instrument. David J. Steele and Charles Kratt, Glasgow Scotland. Filed May 7, 1904.

787,012. System of Electrical Distribution. William A. Turbayne, Lancaster, N. Y., assignor to the Gould-Coupler Company, New York City. Filed June 24, 1904.

787,024. Means for Controlling the Charging of Storage Batteries. Rufus N. Chamberlain, Depew, N. Y., assignor to the Gould Storage Battery Company, New York City. Filed Feb. 8, 1904.

787,032 Rheostat. Fred E. Goodall, Chicago, Ill., assignor to the Hanson & Van Winkle Company. Filed Oct. 6, 1904.

787,047. Electric Resistance. Harry W. Leonard, Bronxville, N. Y. Filed Dec. 8, 1904.

787,057. Wireless Telegraph Transmitter. Harry Shoemaker, Jersey City, N. J., assignor to the International Telegraph Construction Company, New York City. Filed July 29, 1904.

787,089. Variable Resistance or Conductor for Electric Currents. William H. Fahrney, Chicago, Ill. Filed Jan. 10, 1903.

787,192. Means for Transforming Direct Current. Osias O. Kruh, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 9, 1903. Renewed Sept. 1, 1904.

787,193. Frequency-Changer. Osias O. Kruh, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 12, 1903. Renewed Sept. 1, 1904.

787,221. Electrolytic Method. Alexander S. Ramage, Detroit, Mich. Filed Jan. 31, 1905.

787,228. Means for Transforming Direct Current. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 17, 1903. Renewed Sept. 1, 1904.

787,318. Electric Signal Device. Ludwig S. Walle, Brooklyn, N. Y., assignor to Fridtjof Jebsen, Bergen, Norway. Filed Dec 29, 1903.

787,319. Protective Device for Electric Apparatus. Leonard Wilson, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company. Filed May 12, 1904.

THE TELEPHONE WORLD.

Bell Company's Listings in New York.

The American Telephone & Telegraph Company has had listed on the New York Stock Exchange, $10,000,000 additional 4 per cent collateral trust bonds of 1929 and $7,000 additional capital stock, making total amount of collateral trust bonds listed $38,000,000 and capital stock $131,551,400. The Stock Exchange committee recommends that it be empowered to add to the list from time to time, but prior to October 1, 1905, $15,000,000 additional collateral trust bonds, on official notification that they have been issued, according to the terms of application, making total amount authorized to be listed $53,000,000.

Progress of Independent System.

The Citizens' Telephone Company, with headquarters at Barton, Vt., is just five years old. Its manager, Mr. Buzzell, has promised lower rates and extended service. The system now extends from Barton to Woodsville and from West Concord to West Danville and is constantly expanding. It has connections with the People's Telephone Company with 900 'phones, and beyond that is the Canadian People's line with about 2,000 instruments. On the south Mr. Buzzell's system connects at Woodsville with the Woodsville Telephone Company, and at Bradford with the Bradford Telephone Company, and other Independent companies having several thousand patrons. In Orleans County connections are had with the Maguire line, which has over 400 patrons. Mr. Buzzell has been very successful in developing the farmers' lines, and he is beset on all sides to open up new territory. He is extending these lines as fast as possible.

William Busby, president of an Independent telephone company operating in South McAlester and Eufaula, I. T., recently said that "extensions and improvements are the order of the day in telephone business in Indian Territory. We are making preparations now to rebuild our line according to the most approved modern methods. Cheap lines and crude methods might have done in the earlier days, but with the amount of business which is now being done in Indian Territory, the demands upon a system have become fully as exacting as in many larger communities, which have not grown up in times of stress and strenuosity, as have those in the territory."

There is a rumor that there may, in the near future, be lower telephone rates in Pawtucket, R. I., as there is reported a prospect of another company appearing in the field, providing sufficient encouragement can be secured.

The Benson, Minn., Telephone Company has been reorganized as a stock company under the name of the Swift County Telephone Company. The old lines will be removed and replaced by a cable and about 100 miles of farmer lines built.

At Crookston, Minn., the Polk County Telephone Company, capitalized at $50,000, was lately incorporated by F. M. Slyter, C. D. Carter, J. D. Pettit and G. W. Hooper, all of Crookston.

Independents Combine.

At a recent meeting held in Peoria, Ill., one of the largest and most complete Independent telephone associations in the West was perfected. Nearly 100 delegates representing probably one-fourth as many companies, were present, and after formulating a constitution and by-laws, the following officers were elected:

G. H. Glass, Pekin, president; C. A. Camp, Henry, vice-president; Albert Schuler Streator, secretary; B. F. Wasson, treasurer; members of executive board, L. C. Schwerdtfeger, Lincoln; O. C. White, Princeton.

The object of the alliance is to perfect a thorough long distance service in order to successfully compete with the Bell Company.

According to officers of the new association, uniform toll rates fully 30 per cent. less than those formally maintained will be adopted.

Ask State for Help.

The resolution by Representative S. D. Peterson, of New Ulm, Minn., directing the attorney general to investigate the complaint of business men of Springfield, Minn., that unfair methods were used to destroy an Independent telephone line, was unanimously adopted a short time ago by the House.

The resolution alleges that a telephone system is maintaining a general store at Springfield, selling merchandise below cost, for the purpose of destroying the competition of Independent local rural lines and coercing the business men into patronizing the exchange and lines of the telephone system.

At a special stockholders' meeting of the Shaw, Wis., Telephone Company, a resolution was adopted amending the articles of incorporation of said company, increasing the capital stock from $5,000 to $15,000, as it was necessary to do this inasmuch as the original capital had all been used constructing the present lines. With this additional increase of capital the lines will be extended in different directions, into the towns of Brunswick, Drammen, Washington, Pleasant Valley and Clear Creek. It will only be a short time before the farmers of that section of Eau Claire County will be in direct communication with Eau Claire, Chippewa Falls and all long distance points.

E. de los Magee, an attorney, and Dr. Ferdinand Butterfield state that in the interests of a number of San Francisco Cal., and Eastern capitalists they will within the present month make application to the board of supervisors for a franchise with a view to operating a new telephone system in San Francisco.

Superintendent Rice Macauley, of the Seneca-Gorham, N. Y., Telephone Company, has announced that extensions of the line are to be made from Rushville and Middlesex to Bellona Station, to Lewis Station and Flint Creek and to Cottage City on Canandaigua Lake.

The Blanchardville & Hollandale Farmers' Telephone Company of Blanchardville, Wis., has increased its capital stock from $1,000 to $2,000.

Telephones on Target Range.

The work of installing a complete telephone system at the national target range, two miles north of Junction City, Kan., on the Fort Riley reservation, has been completed. Each firing point at the range is connected underground with the butts, where eight telephones will be in operation during the firing. These connections are so distributed that there are two for each set of seven targets, one in front and one in the rear. This system is to be connected with the Fort Riley system, so that it will be possible to talk from any 'phone at the firing points with the post or city. Civilian organizations of marksmen of the West will probably get to use the target range for their events this year and the years following.

J. B. Marquis, Jr., proprietor of the Marquis Telephone Company, of Norwich, N. Y., has purchased 5,000 feet of telephone cable, and will commence the work of installing the cable in the center of the village. The Marquis line, which was established in 1895, with only three 'phones, had a steady growth until in January, 1904, it had 417 'phones. The business has increased 50 per cent. during the past year and Mr. Marquis now has 620 subscribers, and a large Independent line. He has established working relations with other Independent lines, and about June 1 expects to make connections which will afford a through line from Utica to Elmira. After the cables have been installed a new and improved central energy system switchboard will be added to the equipment.

The two telephone companies operating in York, Pa., will ask city councils to grant franchises to construct and operate an underground conduit for their cables and wires. The companies are to give bonds in the sum of $2,000 to restore the streets.

The Winona, Minn., Telephone Company has elected James A. Tawney, John Dietze, Edward Lees, S. L. Wright and J. R. Mitchell as directors, and these have elected the following officers: President, James A. Tawney; vice-president, secretary and treasurer, John Dietze.

The Lake Shore & Michigan Southern and the Pittsburg & Erie Railroad Companies are using telephones with satisfactory results.

The Beaver Dam, O., Telephone Company, of Allen County, has increased its capital from $15,000 to $25,000.

Telephone Incorporations.

The Banner Telephone Company, East Grand Forks, Minn. Capital stock $25,000. Incorporators: Arney Grundysen, O. Osmunden, P. J. McCoy and B. Johnson.

The Streator Independent Telephone & Telegraph Company, Jersey City, N. J. Capital stock, $200,000. Incorporators: Charles N. King, Le Grand Bouker and John J. Reilly.

The Spring Lake & Red Creek Telephone Company, Westbury, N. Y. Capital stock, $1,000. Incorporators: Newton Douglas, Westbury; Benjamin W. Moth and George G. Wood, Red Creek.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Central City, Ky.—C. H. Blandford, city clerk, has sold at public auction to the highest bidder the franchises for electric light and a street railway. B. F. Creech was the purchaser of both franchises. The conditions under which the sale was made are that the electric light plant shall be completed in eight months, and the street railway in 18 months.

Detroit, Mich.—The articles of association of the Peninsular Electric Light Company have been amended so that it may acquire franchises other than those of the original company in other counties than Wayne.

Everett, Wash.—The Snohomish Electric Light & Power Company will extend its lighting system.

Fairmont, Minn.—The citizens have voted to issue bonds to the amount of $18,000 for the purpose of improving the electric light and waterworks systems.

Glasgow, Mo.—The Glasgow Electric Light, Power & Industrial Company, with a capital of $7,000, has been incorporated by W. R. De Witt, of this place, and George H. Milburn, of St. Louis.

Grand Forks, N. D.—The municipal election to vote on the issuance of bonds to the amount of $30,000 for the installation of an electric lighting plant was lately carried.

Henry, Ill.—The electric light plant has been sold by the Sterrerts to J. J. Crickenberger.

Horton, Kan.—The Rock Island Company is contemplating the erection of an electric lighting plant at its shops here.

La Porte, Ind.—Frank R. Northam has been appointed receiver for the Edwards Railroad Electric Light Company.

Lindsay, Neb.—This place is in a fair way to get an electric light plant. There is a fine water power close to town, and parties are now figuring on a dam, and the plant is almost assured.

Middleburg, Pa.—Electric light franchises have been granted in Sunbury, Selinsgrove and Middleburg to George W. Wagenseller, of this place, and David Goltstein, of Pittsburg. It is proposed to organize a company called the Middle Creek Electric Company, of which P. H. Harter, of Sunbury, is to be treasurer, and combine the local companies of the three places and also of Northumberland, to furnish electric light by means of a water power in Middle Creek, two miles below Selinsgrove, where a tunnel will be dug through Naishe's Mountain for a distance of 1,200 feet.

Mishawaka, Ind.—The Indiana & Michigan Electric Company is to be incorporated. The company will have a capital of $200,000,000, and will control over 60,000 electrical horse power generated by huge plants located along the St. Joseph River in this State and Michigan.

Mitchell, S. D.—The Mitchell Gas Company, which is represented by C. C. King, of Scotland, has purchased the electric light plant of this city from J. B. Mikesel.

Mount Hamilton, Cal.—The Lick Observatory is soon to have an electric light plant of its own established on Mount Hamilton.

Muscatine, Ia.—A new electric plant is proposed for this city.

Muskegon, Mich.—The ordinance granting to the Morton B. Wheeler Company a franchise to furnish electric light and power within limits of this city, was recently passed by the council.

Platteville, Wis.—The Platteville Electric Light & Power Company, with a capital of $20,000, will increase the same to $50,000. M. S. Sickle is president, and J. H. Evans secretary.

Richmond, Va.—Plans are being considered for the erection of the new electric lighting, heating and power plant for which the Legislature appropriated $75,000. Samuel W. Bigger, clerk of the capitol rebuilding committee, may be addressed.

Stamford, Conn.—The Rector Electric Light Company of this city has increased its capital stock from $50,000 to $150,000.

Vandalia, Ill.—The Dieckmann Electric & Improvement Company, with a capital of $110,000, has been incorporated here by George A. Dieckmann, J. R. Myers, J. F. Hibbitts and others, to operate a heat, light and power plant.

STREET RAILWAYS.

Athol, Mass.—A corporation with $80,000 capital, to build a trackless trolley system from this city to Barre by the way of Petersham, North Dana and Dana Center, is likely to be formed within a few weeks. John A. Carter, a well-to-do resident of Petersham, is the chief promoter, and others interested are J. S. Noble, of Springfield, and the Noble Milling Company.

Bryan, Tex.—Interested parties in this city have received advices from Austin of the filing in the office of the Secretary of State of the charter for the Bryan-College Electric Railway Right of Way Company. Messrs. N. H. Brown and F. S. Johnston, of College Station, and Messrs. A. W. Wilkerson, J. W. Bates and W. P. Connelly, of Bryan, are named as incorporators of the company.

Buffalo, N. Y.—the Lima, O., Electric Railway & Light Company, which was owned by local men, has been sold to a syndicate representing the Widener-Elkins interests. One of the former stockholders said that the purchase of the road by the syndicate is for ths purpose of completing a line between Lima and Toledo.

Columbus Junction, Ia.—A trolley line will be run from here through Louisa and Henry Counties to Mt. Pleasant.

Mount Vernon, Ind.—The city council has unanimously passed the electric street railway franchise as presented by W. P. Larcy and assigns of Evansville and Princeton granting the company the right to construct and operate an electric railway through the streets of this city.

New Martinsville, W. Va.—The right of way is now being taken for the electric railway which is to be built from here to Middlebourne.

Norwalk, O.—A new electric road from Mansfield to Greenwich, and thence to this city, is projected.

Richmond, Va.—A movement is on foot for an electric line running from the extreme lower end of Charles City County through Charles City and lower Henrico County into this city.

Spokane, Wash.—J. P. Fitch says an electric line will be run from this city to Lewistown, Mont.

Springfield, Mass.—The Springfield Street Railway Company, controlling all of the electric car traffic in this city, and operating 93¾ miles of track, passed into the control of the New York, New Haven & Hartford Railroad Company last week.

Sunbury, Pa.—A trolley line will be built from here to Mifflintown.

Zanesville, O.—Arrangements for constructing the Zanesville, Cambridge & Northern traction line are going forward rapidly.

POWER PLANTS.

Beallsville, O.—L. S. Whitehead, promoter of the Whitehead Electric Light & Power Company here, has filed notice with the recorders of Monroe, Belmont and Washington Counties to the effect that he has appropriated the waters of the Muskingum, Sunfish and Captina Creeks and their tributaries, to be harnessed and used in the manufacture of power for his plant, which will be constructed with the intention of supplying light and electric power throughout Belmont. Monroe and Washington Counties.

Harrison, O.—In order to furnish electric power for factories and other purposes, the citizens of this place propose to harness the Whitewater River.

BIDS WANTED.

Des Moines, Ia.—Sealed proposals will be received by J. W. Campbell and W. W. Wise, of the board of public works in this city, until April 26, for lighting the public parks of the city with electricity, for the term of 5 1-5th months from May 1, 1905. A certified check for $200 is required.

New York City.—The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until April 25 for furnishing Eastern Navy Yards with the following: Schedule 149, cable and electrical supplies. Blank proposals can be obtained at the Navy Pay Office in this city.

San Francisco, Cal.—On May 9 the Bureau will open bids for furnishing the Mare Island and Puget Sound Navy Yards with the following: Schedule 156, conduit, lamp cord, clusters, transformers and miscellaneous electrical supplies. Schedule 157, motors. Applications for blank proposals should designate by number the schedules desired. Blank proposals may be had at the Navy Pay Offices in this city and Seattle.

Washington, D. C.—Sealed proposals for furnishing the Government Printing Office with electrical supplies during the fiscal year 1906 will be received until May 4. Specifications and detailed information furnished on application to F. W. Palmer, public printer, this city. The District of Columbia commissioners are inviting sealed proposals until May 4 for furnishing the various branches of the government of the District with electrical supplies and material during the next fiscal year. Specifications and blank proposals will be furnished on application to the property clerk, District Building, Washington, D. C.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15¼@15⅜c.; casting, 14⅞@15c.

The Edison Electric Illuminating Company of Boston has declared the regular quarterly dividend of 2½ per cent., payable May 1.

President Winter of the Brooklyn Rapid Transit Company says there has been no alliance between his and any other company and none is in contemplation.

The directors of the United Traction Company of Albany and Troy, N. Y., have declared the regular quarterly dividend of 1¼ per cent.

The New York, New Haven & Hartford Railroad Company has purchased the Westfield (Mass.) Street Railway by buying an option on the stock between $160 and $175 per share.

The Havana (Cuba) Electric Railway Company's annual report shows a total surplus of $138,270 for the past year. The surplus for the previous year was only $545.

The Lowell (Mass.) Electric Light Corporation has declared a semi-annual dividend of $4 a share, payable May 1. Books close April 20.

The Butte (Mont.) Electric & Power Company has declared the regular quarterly dividend of 1¼ per cent. on its preferred stock, payable May 1 to holders of record April 27.

The Edison Company of Boston will give its stockholders no new stock rights this year, as its present capital is sufficient to care for its business for another year at least.

The Federal Telephone Company, whose most extensive operations have been in Allegheny County, Pa., is retiring from business and has communicated the fact to the East McKeesport Council.

Approximately 14,000 shares out of a total of 19,854 shares of stock of the Springfield (Mass.) Street Railway Company has been deposited with Lee, Higginson & Co., of Boston, who are financing the deal.

The Municipal Subway Company of New York has been incorporated at Albany with $100,000 capital to build conduits for electrical conductors. The directors are J. Bears, W. J. Boroughs and George Stewart of New York.

Both General Electric and Westinghouse interests admit that the best of feeling no longer exists between the managements of these two companies, which fact is sure to be reflected in rather severe competition.

The Public Service Corporation of New Jersey has increased its capital stock from $10,000,000 to $12,000,000 for the purpose of further developing the property of the company. The new stock will be issued to shareholders at par.

The control of the Hartford (Conn.) Street Railway Company was formally transferred Saturday to the Consolidated Railway Company, the holding corporation of the street railroad properties of the New York, New Haven & Hartford Railroad Company.

The People's Light, Heat & Power Company of Springfield, O., has been incorporated with a capital stock of $2,000,000. The deal is practically closed by which the new company will purchase the Springfield Light & Power Company, now owned by the American Railway Company of Philadelphia.

An alliance between the Metropolitan Street Railway Company of New York and the New York, New Haven & Hartford Railroad Company is now regarded as practically certain, if the Metropolitan system secures the franchise for the construction of new subways between the Bronx and the Battery.

ELECTRICAL STOCK QUOTATIONS.

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Ninth Avenue	197
Third Avenue	131¼
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	70⅛
Brooklyn City Railway	239
New Orleans Railway	4¼
Public Service Corporation (New Jersey)	141
Philadelphia.	
Consolidated Traction of New Jersey	84
Philadelphia Traction	100
Union Traction	60⅞
Boston.	
Boston Elevated	156
Massachusetts Electric Companies, com	21¼
do. do. do. pref.	68¾
West End Street, com	97⅛
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Chicago.	
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Union Traction, com	8⅛
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Electric Lead Reduction	⅛
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do. do. pref.	24
Westinghouse, com	177
do. pref.	192
General Electric	184⅛
Boston.	
Edison Electric Illuminating	255
General Electric	184⅛
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	165
National Carbon, com	62
do. do. pref.	114
Philadelphia.	
Electric Company of America	12¼
Electric Storage Battery, com	86
do. do. do. pref.	86
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Western Telephone Company	18¾
New England Telephone Company	139¼
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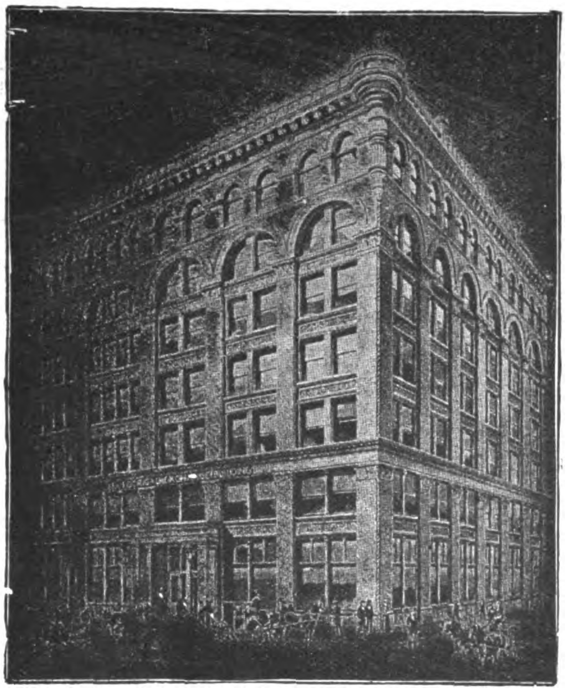

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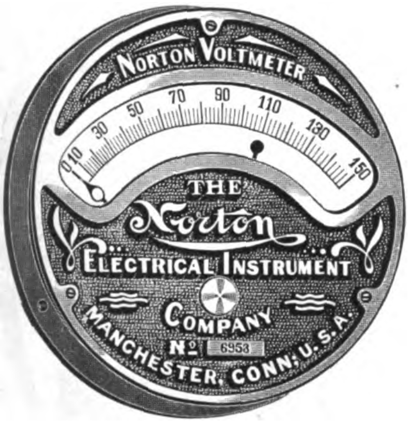
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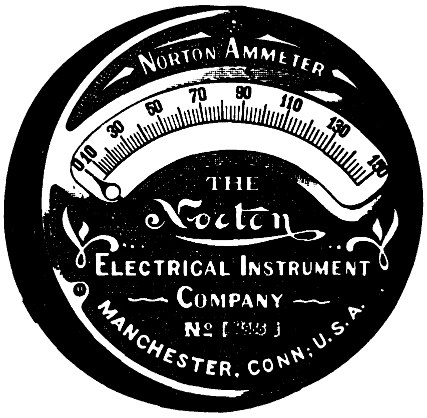
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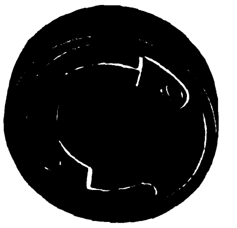

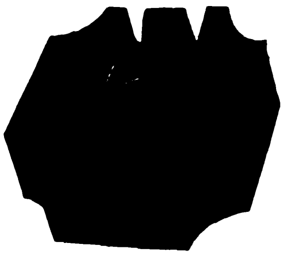

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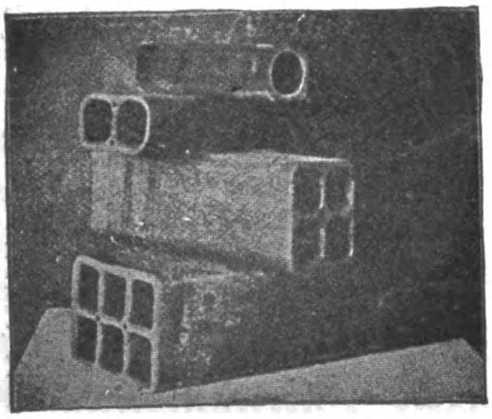

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EDITORIAL NOTES.

When Large Cities Will Have Cheap Electricity.

Agitation and legislation cannot effectively alter the actual cost of electricity. They may impose restrictions, through which a fancied relief is obtained, but the three great fuels of mankind, coal, oil and wood, will still be charged for at a rate which nets a reasonable margin of profit to their owners. The State recognizes the impossibility of imposing its will upon industrial enterprises whose business methods are clean in this respect. It cannot force concerns to sell coal or oil or wood at a loss, and therefore it is in many respects similarly situated with regard to those corporate interests self-intrusted with the great municipal responsibility of supplying electricity for lighting the city streets. These facts are known to be applicable, not only to specific instances where public sentiment has cried out against extortion, but to the great majority of cases where electricity performs this public service.

Therefore, the absolute cost of fuel and the cost of the complete electric light installation are, in the aggregate, the sources of expense—the one permanent the other continuous—upon which are based the charges for electricity. If the fuel charges are reduced to figures admittedly fair by the purchasers, and the installation of a central station and its many accessories is laid down on such economic lines as those best justified by the opinions of the most competent of engineers, then the outlay has not been excessive and it is necessary to consider the financial conditions involved, which must be the cause of such prices as are charged for electrical energy. These, in detail, cannot be adequately reviewed without special provision being made for many pages of statistics. Yet the general reasons may be briefly presented in conjunction with those that will indicate the time when large cities will have cheap electricity.

Among those that may be presented are such as refer to the earlier experimental period of electric lighting, that time during which the system required creation. Plants were constructed and reconstructed, and the entire lower section of New York was covered with an expensive underground network of wires. The earlier history involved heavy expenditures, which partly composes the debt of older companies in the lighting field. Much money had to be sunk before success came, in the shape of enough consumers of current to found the basis of an assured industry. The details, which in the end will constitute the complete elements of a great plant, are not as yet all perfect. Every half decade or decade sees changes of a most important nature. And it can be readily understood that with the swift advance of new devices in the field of electric lighting, the new additions will make as marked a transformation in the central stations of ten years hence as those of ten years ago have made in the present.

While it may be added that overcapitalization also adds its load of financial responsibility to the shoulders of those promoting the interests of electric lighting, frequently this is done in anticipation of a natural industrial growth and for this reason becomes absolutely legitimate. When this is carried on to excess, however, and the dividends that must be paid on watered stock constitute a burden to the community in the way of overcharges for current, it is quite evident that radical measures must be taken to modify such conditions and transfer the load to where it properly belongs.

Large cities will have cheap electricity if the great natural sources of power are employed whose utilization would result in low prices and efficient lighting and heating for even the most humble.

It would be very much better to burn coal at the mines and transmit electricity to New York at high pressure than ship coal here by steam roads for the same purpose. No well-constituted body of electrical engineers would refuse to entertain this idea seriously. On the other hand, water power in the Appalachian and Rocky Mountain ranges for the inland towns, and Niagara toward the north, would supply large amounts of power for industrial purposes. A system of tide motors highly developed has shown great efficiency at several points on the Atlantic and Pacific coasts in the last few years. It may not be too much like unwholesome anticipation to predict the erection of trunk power lines carrying the electrical energy for whole States in the near future. Such a public necessity like light deserves just as much consideration as pure water or fresh air. It will be only a question of time before this idea will burrow its way into the minds of the general public whose wish in this land is law.

* * *

Steam Engine Research.

For some years past a committee of the English Institution of Mechanical Engineers has been carrying out investigations upon the initial condensation in steam engine cylinders. The committee has now issued a lengthy report embodying particulars of what has been accomplished during the past six years.

The engine used for the research was a horizontal compound, with cylinders placed side by side, and of 6½ inch and 11¼ inch diameter and 14 inch stroke. Among the points elucidated were the following: First, leakage through the slide valve had been quantitatively determined under defined conditions, and shown to be nearly independent of speed of sliding surface, and proportional to difference of pressure between the two sides of the valve. Further, the assumption that the leakage was inversely as the overlap of the valve was shown to be at least in the main well founded; and it appeared that with well-fitted valves the leakage might amount to over 20 per cent. of the steam entering the cylinder, and was rarely less than 4 per cent. Second, it had been shown that for an unjacketed engine with a given ratio of expansion initial condensation, expressed as a percentage of the steam in the cylinder, diminished with increase of initial temperature, while the total condensation increased with such temperature increase. This had never before been demonstrated with clearness, since, if leakage were not allowed for, the results were obscured or even reversed. Third, it appeared that the re-evaporation for a given ratio of expansion was as great, and sometimes greater, without jackets as with them, this result showing that the regenerative action of the cylinder walls with a given ratio of expansion was largely independent of their mean temperature. Fourth, the results obtained indicated the temperature at which for any speed of revolution with a given expansion, jacketing would become unnecessary or wasteful.

If the heat units per indicated horse power per minute required by the unjacketed engine for each speed of the series were plotted either on an initial pressure or a mean effective pressure base, the points for each speed would be found to lie on four curves, which became closer and closer to each other as the speed increased and converged to a point as pressure or temperature increased. When the heat consumption for the jacketed series was likewise plotted, the points for the different speeds at each pressure lay irregularly round a point, their exact position being determined by the accidentally slight variations of the conditions of each trial.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Several electric vehicles will be seen in the annual automobile parade in this city next Saturday. The parade will be under the auspices of the Automobile Club of America.

Prof. Wilhelm Ostwald, of the University of Leipsic, regarded as one of the founders of the modern science of physical chemistry, has been invited by Harvard University to serve as lecturer during the first half of the coming academic year.

Prof. A. S. Eve, of McGill University, Montreal, has discovered that the mere presence of radium in his laboratory prevented him from making a delicate electroscope. He found that all the materials in the building had been effected with radium activity. He got rid of some of the infection by washing the articles in hydrochloric acid, but enough was left to spoil the laboratory. The scientists at Columbia University, New York, have also discovered that their physical laboratories are being injured by radium. Not only have hundreds of thousands of dollars' worth of instruments in the laboratories here and elsewhere been "radiumized," but the gas given off from the radium prevents and will prevent for years to come the manufacture of any delicate electrical instruments in the laboratories. It is like spoiling a storeful of watches by bringing a magnet in their midst. A little piece of radium no bigger than a pea will put a whole laboratory out of business in no time and keep it out of business for two generations so far as electrical instruments of precision are concerned. It is claimed that new laboratories will have to be built especially for radium.

Prof. H. W. Spangler, of the University of Pennsylvania, will open a discussion on "Internal Combustion Engines" to-morrow (Thursday) evening at a meeting of the Franklin Institute, Philadelphia.

Prof. M. I. Pupin has been nominated for the award of the Cresson medal by the Franklin Institute for his "Art of Reducing the Attenuation of Electrical Waves and Apparatus."

The New York "Herald" printed the following in its Sunday issue: "It is understood that the agreement between the General Electric and the Westinghouse Electric & Manufacturing Companies regarding prices has been ended and that a reduction in prices of electrical equipment may be the immediate result. The two companies, during the last few years, observed an arrangement concerning certain kinds of electrical equipment whereby each secured its share in the business field agreed upon. Relations between the companies became strained during the last few months and the climax was reached when the Allis-Chalmers Company entered into the electrical field."

Prof. Charles P. Steinmetz will present two papers at the annual convention of the American Institute of Electrical Engineers, to be held at Asheville, N. C., June 19 to 23. The subjects will be "High Potential Oscillations of High Power in Large Power Distribution Systems," and "Theoretical and Experimental Investigations on the Disruptive Strength of Air at Very High Voltages."

The Chinese Government, according to an official report to the State Department at Washington, D. C., has granted its first patent. It is for an electric lamp, the inventor being an inhabitant of Nankin, the old capital of the Chinese Empire. The patentee calls his invention "bright moolight."

THE FRENCH FAYET-CHAMONIX MOUNTAIN ELECTRIC RAILWAY.

BY FRANK C. PERKINS.

A most interesting third-rail mountain railway was constructed by the Compagnie des Chemins de Fer de Paris-Lyon et a la Mediterranee between Cluses-Fayet and Chamonix in the Mont Blanc region of France. The first section of the line between Cluses and Fayet-St.-Gervais was not difficult to construct, but the second section between Fayet-St.-Gervais and Chamonix extended a distance of 19 kms. with a difference of level between the two stations of 458 meters while at certain parts the grades were exceptionally steep and many difficulties were encountered which required great engineering skill. The last section was electrically equipped with the third-rail system and followed along the valley of the Arve, crossing the same at several points, a number of bridges being required with spans varying from 25 to 45 meters. The viaduct of Sainte-Marie on this section has an arch of 25 meters span and 50 meters high with seven additional arches each having a span of 15 meters. One portion of this viaduct has a curvature of 200 meters radius. There are also three tunnels, one of which is 126 meters in length between Fayet and Chamonix the grades varying from 2 to 9 per cent., one grade of the latter amount extending a distance of 2,155 meters and another of 8 per cent. being 1,386 meters long There are four intermediate stations including Bossons, Houches, Servoz and Cheddes.

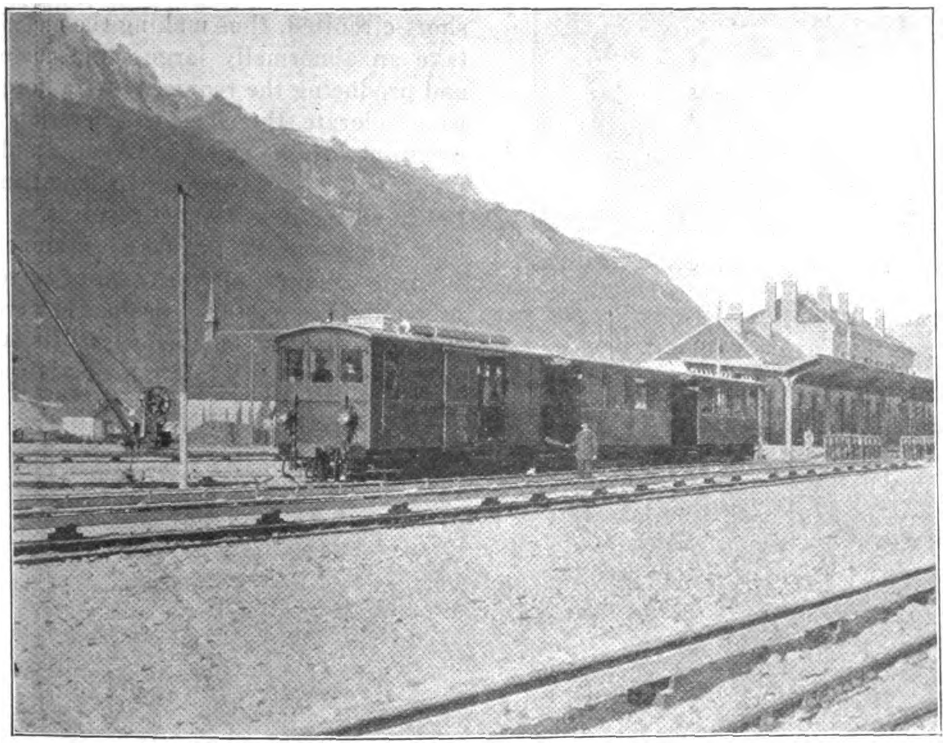

Fig. 1.—Motor Cars and Station of Mountain Electric Railway.

The current for driving the electric trains on this third-rail line is supplied from two generating stations, one located at Servoz, which supplies the first electric railway section, and another at Chevants, supplying the electric line extended towards the Swiss border and to Martigny. The Servoz station utilizes the water power from the river Arve, having an output of 12 cubic meters of water in summer and 6 cubic meters in winter, the effective head being about 40 meters. The Chevants power plant is supplied by a second branch of the Arve, the output being 11.5 cubic meters in summer and 5 to 6 cubic meters in winter with an effective fall of 94 meters. The current is supplied by four direct current electrical generators of 200 kw. each, directly connected to horizontal turbine shafts by flexible insulating couplings, the speed being 715 r. p.m. at no load and 450 r.p.m. at full load; the regulation is provided by compounding the generators. It is stated that the machines operate at no load at a speed o about 600 r.p.m. with a pressure at the terminals of about 550 volts, while with a load of 300 amperes, the speed dropping to 450 r.p.m., the pressure at the terminals is increased by over-compounding to take care of the loss in the feeders to over 650 volts. The Servoz station has a minimum output of over 2,000 hp. and a maximum output of 4,500 hp., the effective fall, as stated, being about 40 meters, and the water is utilized after leaving this plant by the he power station of the Cheddes Electro-chemical Works whose turbines operate under a head of 140 meters.

The Chavants power station was installed at a distance of about 10 km. from Fayet-St.-Gervais, the total capacity being 10,000 hp., the turbines having a normal flow of about 10 cubic meters under a head of 94 meters. A high tension alternating current is generated at a pressure of 10,000 volts for use on the transmission line, step-down transformers being utilized at various sub-stations along the line. The turbines and generators are of 1,200 hp. capacity, the current generated by these three-phase alternators having a frequency of 25 cycles per second. Rotary converters are installed at the sub-stations for supplying direct current to the mountain railway line and storage batteries are also provided for regulation.

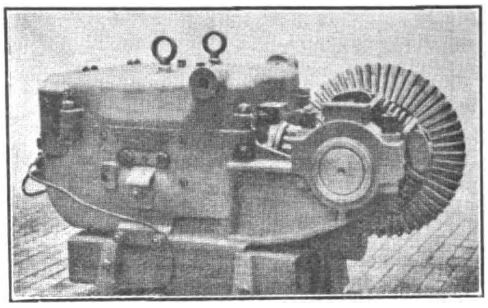

Fig. 2.—Electric Railway Motor and Reduction Gear.

The Fayet-Chamonix third-rail electric line has a gauge of 1 meter, the track consisting of Vignole rails 12 meters long and weighing 34.2 kg. per meter. The third-rail is used for supplying current to the electric motors on the trains and is of the same weight and section as the running rail, its upper surface being 23 cm. above the level of the track and located 1.083 meters away from the running track, in some cases on the right hand side and in others on the left. On this account two sliding contacts are provided on the cars so that current may be taken from either side of the track. In this way crossings and switches as well as changes of level do not cut off the current as one conducting shoe is always on a live rail. In order to prevent accidents from coming into contact with the live rail, which carries a current of 550 volts, it is protected by a wooden covering for a length of 10 meters on either side of the grade crossing. The third-rail is provided with brown plastic bonds and is insulated by paraffined wood supports. This mode of insulation is said to be very effective, the current leakage being less than 1 ampere per kilometer. It has been stated that the losses in winter from snow and from rain are very low, due to the fact that the water in the neighborhood of Chamonix is almost chemically pure on account of the purity of the atmosphere and is therefore a very poor conductor. It is stated that the rain washes off the dust from the insulating supports and there is even a less leakage than before.

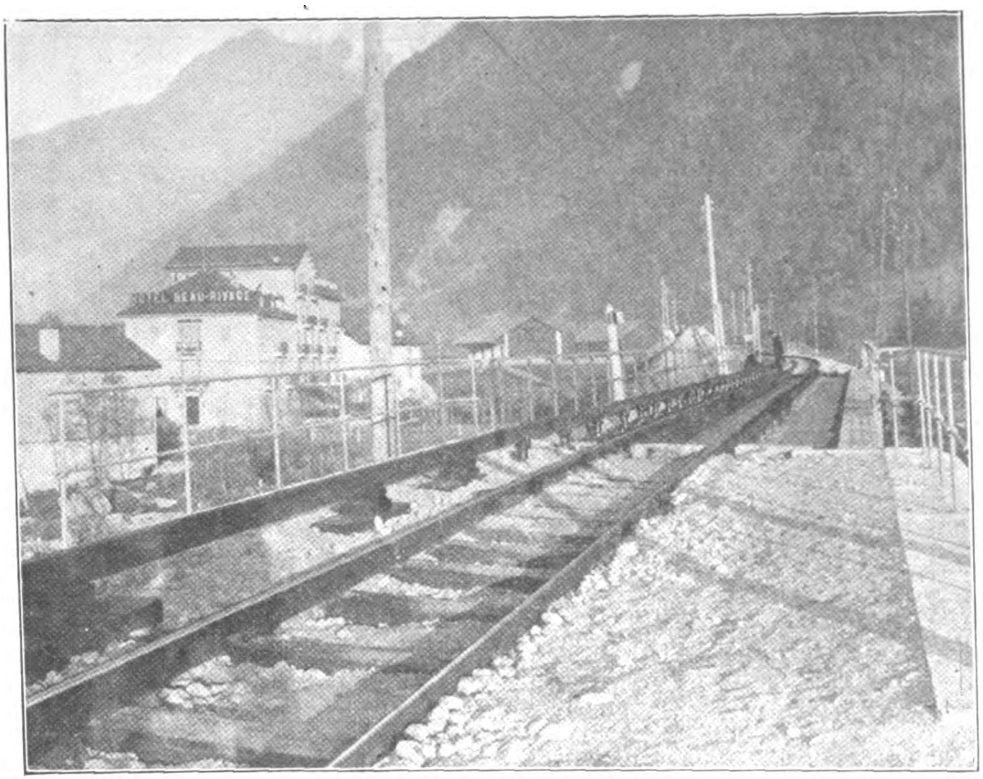

Fig. 3.—Track Construction and Third Rail of Mountain Electric Railway.

The cars and electric locomotives were constructed by the Societe Nouvellex des Etablissements de l'Horme et de la Buire of Lyons, France, while the electrical equipment of the same was supplied by the Society d'Electricite Alioth, of Munchenstein-Bale. There are on this line 80 motor cars as well as a number of trailers, the former weighing about 20 tons each and equipped with two 65 hp. electric motors each, the trains being operated on the multiple unit control system. There are ten passenger and freight trains operated on this line each way daily, a number of the motor cars on the passenger trains being provided with baggage compartments. The cars are provided with automatic and hand brakes as well as Christensen air brakes, an electrically operated compressor supplying the necessary air pressure. The trains operate at a speed of from 15 to 40 km. per hour, the latter speed being attained on the level portions of the line and the former speed when operating on heavy grades. The motors when operating at a speed of 275 r.p.m. take a maximum current of 200 amperes, when supplied with direct current of 550 volts pressure. The cars are lighted by a dozen 16 cp. incandescent lamps each and are also electrically heated.

Fig. 1 shows the motor car and one of the stations. Fig. 2 shows the motor inclosed and connected with its reduction gearing, which illustrates well the method of transmitting the power to the car axles on the Fayet-Chamonix line.

Fig. 3 shows the track construction and live rails at one of the stations while Fig. 4 shows a couple of electric railway motors used on these trains under test.

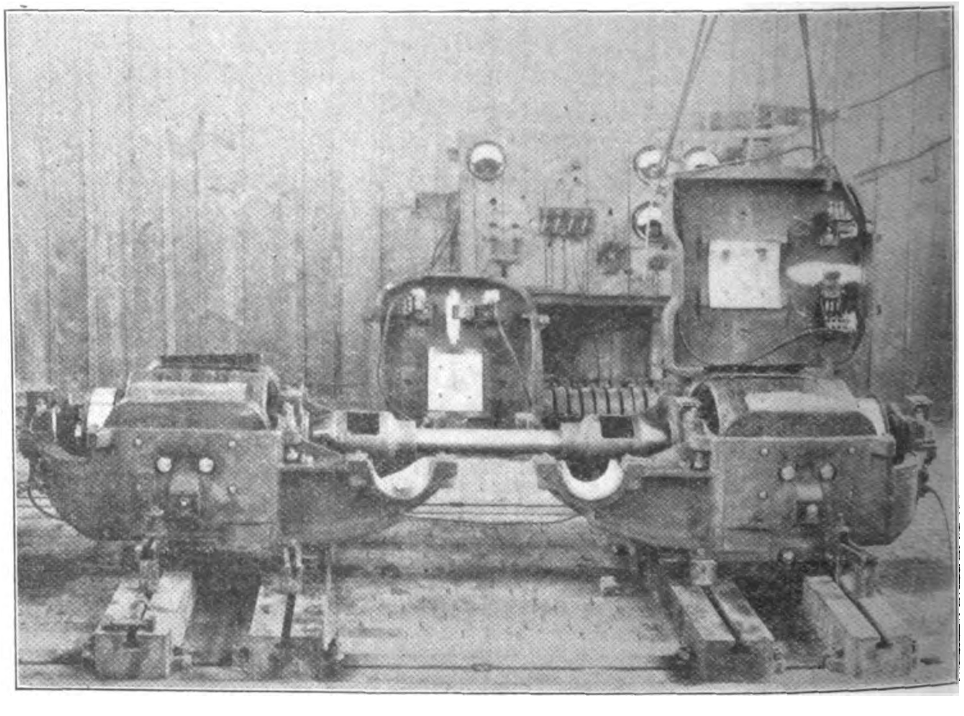

Fig. 4.—Test of Fayet-Chamonix Railway Motors.

* * *

A large amount of electrical business is coming to hand in New York from Central and South America, whose cities are now being equipped with electric street cars and electric lighting plants.

ELECTRICALLY-DRIVEN LIFTS.*

BY F. O. HUNT.

The question of the most suitable type of lift motor is a matter upon which considerable difference of opinion still exists. In some few cases series-wound motors have been used, but the practice can only be condemned as hopelessly bad. The choice lies, therefore, between shunt and compound winding. The reasons given by the advocates of shunt winding are mainly greater simplicity of only one magnet winding, less space taken by insulation, and greater simplicity of the controller. Where, however, shunt winding is used, it is usually designed as if for a lower voltage than that on which the machine is to be used, and a resistance is placed in series with it During the process of starting this resistance is short-circuited, thus making the machine take an abnormally large shunt current and producing the required extra torque to accelerate the load. Alteration of grouping of the shunt coils on a multipolar motor is also adopted by some firms, but in either case the net result is to obtain the required increase of ampere-turns by an addition to the shunt current taken by the motor. Seeing, however, that the greatest trouble with lifts supplied from public lighting mains is their tendency to cause fluctuation of voltage by their demand on the mains at the instant of starting, it is difficult to see how the shunt winding can be really as satisfactory as a properly designed compound-wound motor arranged to have its compound coils cut out after the process of accelerating is accomplished. The compounding merely takes the place of the last section of the starting resistance, so the complication of the controller is more imaginary than real. In this case the increase in ampere-turns is obtained by an alteration of the number of active turns, while the current value remains unchanged. In whichever way the increased excitation is obtained, it is essential that the magnetic density in the field magnet should be kept low so that the temporary increase in excitation shall be as effective as possible in augmenting the field strength, and consequently the starting torque. of the motor.

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*Abstract of paper read before the Newcastle (Eng.) Local Section of the Institution of Electrical Engineers, March 20, 1905.

Where cheapness is an essential, hand-rope gear is at present the commonest method of operating the reversing and circuit-breaking switches. It usually consists of a more or less direct mechanical connection between what is virtually the handle of the switch and a rope. In many cases the reversing and circuit-breaking functions are both performed by the same switch, but there appears to be a tendency to separate the two operations. Probably this arises from the fact that with this arrangement it is possible to adopt more effective measures for magnetically blowing out the inevitable arc at the contacts. When speeds of more than 160 feet per minute are required it is now becoming usual to supersede the mechanical hand-rope transmission by an electrical method, in which the attendant merely moves a switch in the case. Where the cage-switch method is used the general practice is to avoid taking the actual power circuit to the cage, owing to the probabilities of trouble where heavy flexible cable is required. An independent circuit carrying a comparatively small current is led into the cage, this current being used to energize the operating solenoids of the power switches.

Formerly the American method of causing the motor to provide mechanically the motion necessary to cut out its own starting resistance was very much in favor and it is still retained by some makers owing to its inherent properties of preventing the motor being started against an overload, and also the certainty of a definite time being taken to cut out the starting resistance. It has, however, the serious drawback that, unless further auxiliary apparatus is employed, it is necessary that sufficient current to start the motor shall pass through it on the first contact stud. General practice now appears to tend in the direction of obtaining this motion electrically even when hand-rope control is in use. The time element during the process of acceleration is usually obtained by means of an air or oil dash-pot. To avoid the use of a dash-pot, some makers adopt an air-vane geared up to run at a very high speed. There appears, however, to be still room for improvement, as all methods of slowly-moving contact makers over studs are more destructive than intelligent hand working. What is wanted is a quick movement from one stud to the next and a prolonged pause on each stud, but an intermittent motion such as this is always difficult to obtain by mechanism that is at once cheap and reliable.

In the early days of electrically-driven lifts brakes were exclusively a mechanical matter and are so still in many cases where hand-rope control is adopted. When electrical control is used, it becomes necessary to lift off the mechanical brake magnetically, thus insuring that when current is "off" the break is "on," and vice versa. In the design of magnetically-lifted brakes there appears to be still room for improvement in the direction of arranging the link work so that the solenoid has a considerably greater mechanical advantage at the beginning of its travel than at the end, thus compensating for the inherent property of the solenoid that its pull is weakest where it is desirable that the greatest force should be available.

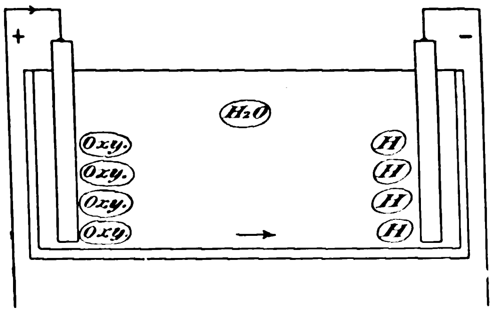
The supplementing or replacement of the mechanical brake by a retarding device depending on electromagnetic action, due to the motor being used as a dynamo, is a development which is growing in favor and undoubtedly further changes in the same direction may be expected in the near future. The facts that such a device can be made much more even in its action and is capable of much finer adjustment than any brake depending on an erratic coefficient of solid friction are strong points in its favor. Where only mechanical braking has been used, the writer has seen the end of the motor shaft twisted off by the action of the momentum of the armature combined with an excessively severe application of the brake. This latter circumstance is always liable to occur owing to the anxiety of the maker of the hoisting gear to reduce the error in stopping at floors to a minimum. The ideal brake evidently should be such that the armature will be caused to dissipate the whole of its own kinetic energy in the same time that the mechanical brake is performing a similar office for the mechanical parts of the system, thus relieving the motor shaft from all twisting stresses no matter how quickly the stopping may be done. Where push-button systems are in use the range of error in the stopping point becomes rather an important matter. Some makers provide two additional buttons in the cage to enable the user to adjust its position with regard to the floor. What really is required in such a case is a method of varying the braking effect according to the load in the cage.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

ELECTROPLATING.

Theory of Electrolysis.—That which is called electrolysis is a department of electricity which treats of the effect of a current upon a so-called chemical compound. By this is meant, that water, for instance, will succumb to the influence of electricity and become the two gases, oxygen and hydrogen, its actual constituents. And the same is true of other forms of matter as well. The action of a current is said to decompose the original body, and overcome in part or wholly the chemical affinity which exists between the elements of which it is composed. It is impossible to pay the proper attention to the effect of a current upon a solution within which are placed electrodes, unless the modern aspect of this branch of practical science is correctly presented. To accomplish this, it must be stated that the chemical theory has been supplanted by the electro-chemical theory, and this theory is based upon the idea that all elementary forms of matter possess charges of electricity. Some such a conclusion was necessary on account of the quality of valency possessed by atoms and molecules. By this is meant the peculiar choosing power, of oxygen for instance, for two atoms of hydrogen or of hydrogen for chlorine, etc. In other words, the elements when in the form of atoms have strange likes and dislikes which manifest themselves in the form of certain affinities for each other. Through these fixed affinities, the elements, as they are called, form chemical combinations, as in the case of water or acids or any other familiar or unfamiliar form of matter. This choosing power inherent in the atoms, given by chemists the name of valency, is attributed to varying charges of electricity by the electro-chemist. Thus the combination of oxygen and hydrogen is due to the electrical attraction of oxygen for hydrogen. On this basis, either one or the other must have a positive or negative charge. This charge, if powerful enough to form so intimate a combination, must be highly concentrated, because of the exceedingly small dimensions of the atoms and molecules themselves. In the case of water, it is a well-known fact that a current of electricity will decompose it into oxygen and hydrogen; and the curious phenomenon presenting itself under these circumstances will be that of the oxygen always clinging to the positive pole of the battery and the hydrogen to the negative. Placing two copper plates in a slightly acidulated solution, connected to a source of electricity, will demonstrate this principle. The great mass of bubbles at the negative pole will serve to prove that twice as much hydrogen as oxygen is evolved. The combination forming water being two of hydrogen to one of oxygen, the gases collected will be in harmony with this proportion. As far as the practical application of this principle is concerned, the amount of gas evolved by this process can be calculated with mathematical certainty. Not only is this true, but if the two poles of a battery, which when employed for electrolytic work are called electrodes, are used in connection with a metal salt solution such as water and sulphate of copper, a coating of copper will be deposited upon the negative electrode, which as well, can be estimated beforehand with the greatest accuracy. The estimates made in the case of the gas refer to the quantity of it which will be evolved per unit of time. In the case of the copper the same holds true. In both cases the fact is clearly presented that certain conditions must be considered as follows:



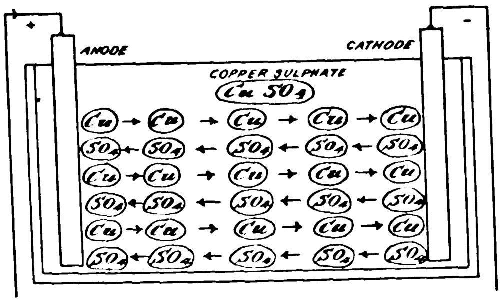
The division of the water molecule into oxygen and hydrogen.

First—The strength of the current in amperes.

Second—The time in seconds during which the current flows.

These considerations lead to an examination of the hypothesis which is supposed to explain that which is called electrolytic action. The two battery terminals, called electrodes, are also named with reference to further distinctions. The positive pole is called the *anode*, the negative pole the *cathode*.

The Grotthus Hypothesis.—According to this hypothesis framed by Grotthus, when metals are being deposited, a curious transference of metal is taking place within the solution. Take, for instance, the case of copper being deposited from a solution of sulphate of copper. The chemical aggregations composing the copper sulphate are as follows:



The migration of the anions and cathions under the directive influence of the current.

Copper sulphate = $Cu\,SO_4$.

This is divided up into two groups of atoms, one of which is positive and the other negative. The sub-divisions are those of the copper, and the oxygen and sulphur as follows:

Copper = Cu moves toward the cathode.

Oxygen and sulphur = SO_4, moves toward the anode.

According to this idea the electrolytic bath with the two electrodes immersed is traversed by two streams of atoms, one going to one pole, and the other to the other pole. But according to the Grotthus hypothesis, the solution of copper sulphate and the two streams of traveling atoms act in a very interesting manner toward each other. The solution of copper sulphate, for instance, permits a copper atom to leave the copper anode from which it has been electrically removed; seizes it, but sends on its own atom of copper in place of the first to its destination, the cathode. The same process is carried out with respect to the oxygen-sulphur molecule. Thus the solution acts as an intermediary, whose strength will remain unaffected as long as the anode replenishes the lost atoms.

An exchange goes on continually, with the result that the copper anode will gradually become lighter and its metallic equivalent will be found at the cathode or on the objects placed there to receive it. These two oppositely moving streams of electrified particles have been designated streams of ions, from the idea that these infinitesimal forms of electrified matter are, as the word expresses it, travelers.

If the anode is of a neutral metal, for instance, or of carbon, then the solution used in this experiment, will systematically weaken.

The Electro-Chemical Equivalent.—The carriers of electricity being these ions, it follows as a logical consequence of this hypothesis, that these ions may or may not carry equal quantities of electricity in the electrolytic experiment. To satisfactorily settle this question, a series of baths of silver solution, copper solution, etc., were prepared with electrodes of the proper character. The current sent into each was carefully measured, and the time during which this current flowed correctly gauged. It was found that in each case different results were obtained, although the current was preserved at a uniform value. The amount of metal deposited, of silver or copper as the case presented showed, were different in each case. In other words, a broad principle was discovered underlying these experiments, a principle which showed that each particular metal was unique in this respect, that its ions or charged atoms were each the carriers of only a specified amount of electricity which was different with every different form of matter tested. The metals particularly, displayed such differences that a table was drawn up, called the table of electrochemical equivalents, under whose heading was given the exact weight of metal carried over by one ampere in a second. This, in fact, is the definition of the electro-chemical equivalent of a metal; the weight of the metal in grams carried over by a coulomb of electricity, that is, an ampere second. On this basis, the weight of any metal, such as gold, silver, copper, lead, etc., carried over by a certain current in a certain time, can be readily ascertained by a simple calculation.

How to Calculate the Weight of Metal Deposited.—In practical electroplating the judgment and experience of the plater is employed to its fullest extent in the determination of the amount of metal deposited on an object being plated. The weight of metal can be calculated from a knowledge of the time in seconds and the strength of the current in amperes as follows:

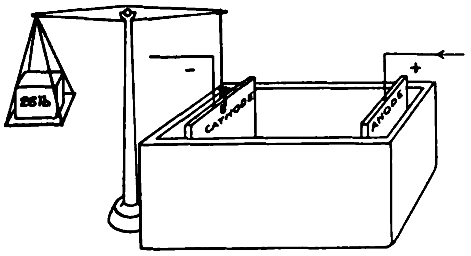
Weight in grams = weight per second per ampere × current in amperes × time in seconds. Reducing to symbols, the formula reads:

$$W = T \times E.C.E. \times C.$$

Where W = weight of metal deposited in grams.

T = time in seconds.

E.C.E = the electro-chemical equivalent (that is, the weight of metal due to one ampere in one second or one coulomb). To illustrate this idea suppose a current of 100 amperes is employed for copper plating for 100 hours, then as the electro-chemical equivalent of copper is .0003281 the total weight of copper plated over would be



Electrolytic deposit of 26 pounds of copper in 100 hours with 100 amperes.

Grams = 3600 × 100 × .0003281 × 100.
Grams = 11811.6.
Total weight = 11.8 kilograms.
Total weight = 26 pounds of copper.

This is the influence causing discrimination between the ions for either anode or cathode in electrolysis. When copper plating is done the Cu and SO_4, or copper and so-called sulphion, divide, the copper depositing on the cathode and the sulphion forming sulphuric acid by combining with hydrogen giving H_2SO_4 and thus intensifying the acidulation of the solution.

Table of Electro-Chemical Equivalents.—To calculate the weights of metal or gas carried over to the cathode by electrolytic action a reference table is supplied giving the name of the element, its atomic weight, its valency, its chemical equivalent and its electro-chemical equivalent:

TABLE OF ELECTRO-CHEMICAL EQUIVALENTS.

Elements.	Atomic weight.	Valency.	Chemical equivalent.	Electro-chemical equivalent in grams per ampere second.
*ELECTROPOSITIVE.				
Hydrogen	1	1	1	0.000010384
Potassium	39.03	1	39.03	0.0004053
Sodium	23	1	23.00	0.0002388
Gold	196.2	3	65.4	0.0006791
Silver	107.67	1	107.67	0.0011181
Copper (Cupric)	63.18	2	31.59	0.0003281
Mercury (Mercuric)	199.8	2	99.9	0.0010374
Tin (Stannic)	117.8	4	29.45	0.0003058
Iron (Ferric)	55.9	3	18.64	0.0001935
Nickel	58.6	2	29.3	0.0003043
Zinc	64.9	2	32.45	0.00033698
Lead	206.4	2	103.2	0.0010716
ELECTRONEGATIVE.				
Oxygen	15.96	2	7.98	0.00008286
Chlorine	35.37	1	35.37	0.0003673
Iodine	126.54	1	126.54	0.0013140
Bromine	79.76	1	79.76	0.0008282
Nitrogen	14.01	3	4.67	0.00004849

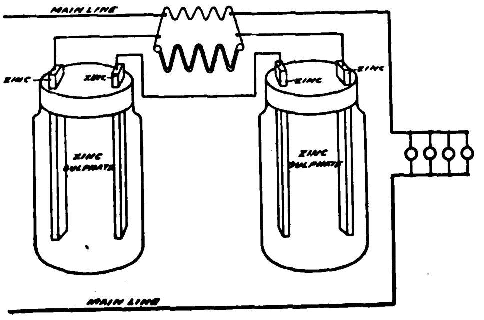
*Table from S. P. Thompson's "Electricity and Magnetism."

In the above calculation the 3600 is the number of seconds in one hour, then follows the E.C.E. and the 100 amperes.

Anions and Cathions.—The atoms carried forward to the negative plate or cathode are called cathions and those passing the anode are called anions. The metals all move toward the cathode and are therefore termed cathions, also the gas hydrogen, which thus betrays the properties of a metal in an electrical sense. The anions are oxygen, chlorine or other elements moving toward the anode. This peculiar qualification has led to the conclusion that the natural charge possessed by atoms determines their position in the electrolytic bath as anions or cathions. The so-called anions or ions with an attraction for the positive electrode are regarded as negatively charged and are called "electronegative." The cathions the reverse or positively charged.

The idea of employing an electrolytic meter to determine the amount of current consumed by customers from the increased weight of the electrode is based entirely upon the electro-chemical equivalent.

The original Edison Illuminating Company of New York used thousands of zinc sulphate meters, composed of two electrodes of zinc in a zinc sulphate solution and receiving a shunted current from the customer's mains. Each month the meters were replaced by new ones and the added weight of the cathodes of the old ones carefully ascertained. The number of ampere hours were thus determined on the basis of the electro-chemical equivalent.



Equipment of Edison meters of the Electrolytic type. Low voltage obtained from drop in shunt.

The final estimates were based upon the number of milligrams of zinc deposited, each of these costing a certain amount, the total weight giving the bill for current.

* * *

CONVERSION OF A TELEPHONE EXCHANGE FROM THE MAGNETO TO THE CENTRAL BATTERY SYSTEM.*

BY B. S. COHEN.

When an existing telephone system has to be converted from one method of working to another, a considerable number of important points immediately present themselves for consideration, the point of chief importance being the necessity for carrying out the conversion with the minimum of inconvenience to the telephone public.

It may be interesting to many to outline the methods which have been adopted for carrying out such a conversion.

The methods to be described have been employed in the main in connection with a considerable number of large exchanges in this country.

The requirements of the new exchange as regards commencing equipment and ultimate capacity are the first consideration, and to this end the department dealing with the traffic furnishes complete records of the normal daily exchange load for the various kinds of local and junction services, and also particulars of the past rate of increase and estimated future increase in the various types of services.

From these particulars the number of lines which an operator can deal with and the number of operators' positions required are determined. In the conversion of a large area with a considerable number of exchanges, the design is complicated by the necessity for allowing for a lighter operator's load during the transition period when the exchanges in the area are working partly on the old magneto and partly on the new central battery system, and the junction work is consequently more difficult than when the conversion of the whole system is completed.

The operators' load is settled on the

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*From the "Electrical Review," London.

basis of calls per busiest hour, and it is interesting to note that there is a constant ratio between this figure and the total calls per day which varies very slightly, if at all, in any one exchange.

This ratio, however, varies for different types of exchanges, and is largest in exchanges where a considerable proportion of the area served is residential, as in such cases the calls are spread well over the whole day, the morning and afternoon maxima and the lunch and early and late minima on the load curve not being so steep as in the case of an exchange in a business area.

The ratio of local calls to calls for other exchanges is another important particular which must be supplied by the traffic department. As illustrating the importance of this point, it may be mentioned that in many exchanges the local calls form such a small percentage of the calls for other exchanges that the subscribers' multiple used for the former gets very little work and in such cases it is quite feasible to economize in the number of multiple spring jacks by spreading out the multiple. For example, in a 12,000-line exchange, by making the subscribers' multiple repeat every 9 panels, or 6 feet 4½ inches, instead of every 8 panels, or 5 feet 8 inches, a saving of about 67,500 multiple jacks is effected, costing with labor of wiring, etc., about £2,250, and it must be borne in mind that this is effected without detracting from the commercial efficiency of the switchboard. It follows from this that if the proportion of local calls became very small, it would pay in practice to do away altogether with the subscribers' multiple. As the junction multiple on the incoming junction boards is used for every connection, the foregoing does not apply, and indeed it is customary to reduce the number of panels per complete multiple on such boards.

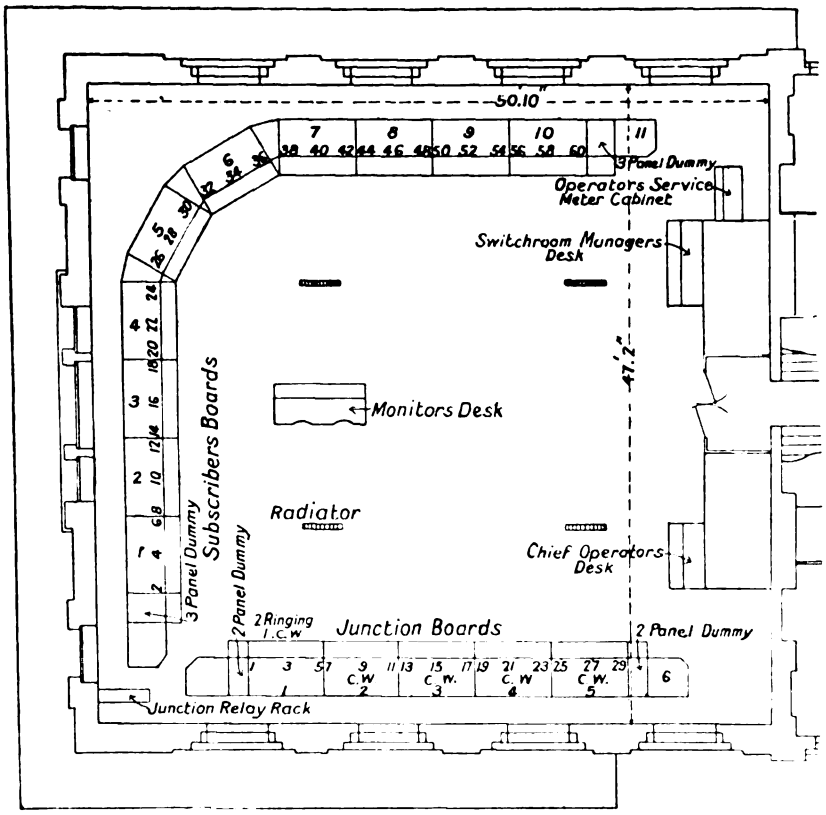

50.10"
47.2"
7
8
9
10
11
38 40 42 44 46 48 50 52 54 56 58 60
3 Panel Dummy
Operators Service Meter Cabinet
Switchroom Managers Desk
Monitors Desk
Radiator
Chief Operators Desk
Subscribers Boards
3 Panel Dummy
2 Panel Dummy
2 Ringing I.C.W
Junction Boards
2 Panel Dummy
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29
C.W 2
C.W. 3
C.W 4
C.W. 5
6
Junction Relay Rack

Fig. 1.—Conversion of a Telephone Exchange.

The size and general design of the exchange having been settled, the selection of suitable premises is the next consideration. The situation of the exchange with respect to the subscribers depends to a great extent on the variation in the density of the subscribers in the different localities served, and is complicated to a certain extent by wayleave considerations and the physical nature of the area.

Assuming that the old exchange is in the most suitable position for serving its subscribers, the new premises would be obtained as close as possible to the existing one.

It very rarely happens that the latter can be utilized for the new exchange, and whenever possible new premises are built specially designed for the work. It is advisable to put the apparatus and accumulator rooms as near as possible to the switchroom, in order that the cables between the two should be of a minimum length. On the other hand, the operators' dining rooms, etc., should also be in close proximity to the switchroom. In practice a satisfactory arrangement for exchange premises which is often met with would have the apparatus and accumulator rooms on one floor, the former containing the main and intermediate distributing frames, power apparatus, etc. The operators' dining, recreation and cloak rooms would be on the next floor above, and the switchroom on the top floor, to allow of roof lighting.

The ideal shape of such a building should be rectangular with a minimum width, such that a whole number of switchboard sections can be turned in the switchroom, thus avoiding the use of dummies at the bends. This is an important point, as in an exchange known to the writer the bad shape of the building has necessitated a considerable number of dummies, the capital locked up in which represents an annual revenue of several hundreds of pounds.

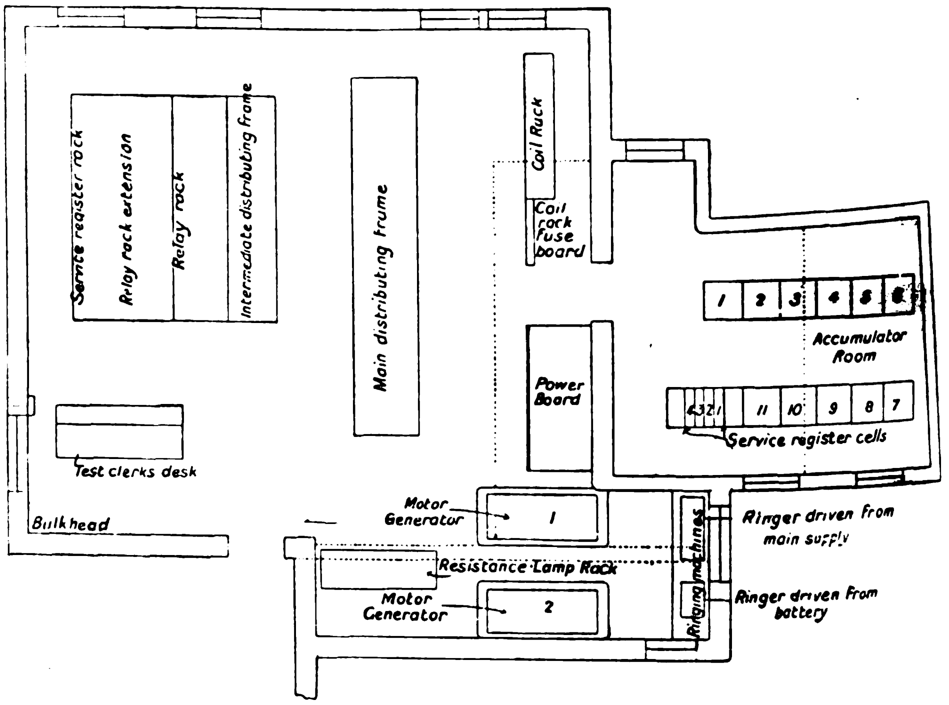

Service register rack
Relay rack extension
Relay rack
Intermediate distributing frame
Main distributing frame
Coil Rack
Coil rack fuse board
Power Board
1 2 3 4 5 6
Accumulator Room
4 3 2 1 11 10 9 8 7
Service register cells
Test clerks desk
Bulkhead
Motor Generator
1
Resistance Lamp Rack
Motor Generator
2
Ringing machines
Ringer driven from main supply
Ringer driven from battery

Fig. 2.—Norwich Exchange, Apparatus Room.

A plan of "North" switchroom, a new exchange of the National Telephone Company serving a portion of the north of London, is illustrated in Fig. 1. It will be seen that the subscribers' sections sweep round one side of the room and the incoming junction boards round the opposite side, both runs of boards starting from the same corner. The capacity of this switchroom is quite small, being only about 4,200 subscribers and 486 incoming junctions, but it has been selected as an example approaching the ideal arrangement. It may be of interest to mention that this exchange is built in an old chapel, at one time the property of the Sandemanians, at which it was stated Faraday himself was wont to attend.

A typical method of arranging the apparatus room is illustrated in Fig. 2. This shows the method adopted at the Norwich exchange. The outside lines terminate on the main frame, which also carries the lightning and stray current arresters. This frame is generally arranged to give a capacity for outside cable leads of at least 25 per cent. more than the ultimate capacity of the exchange, in order to allow for non-utilized wires in cables. This frame can be extended when necessary. The main frame has displaced the old-fashioned test board as with the central battery system the nature of practically all faults can be determined from the multiple.

The intermediate frame cannot be conveniently extended and is installed with the ultimate capacity. A detailed description of the foregoing and other apparatus shown in the plan in Fig. 2 is beyond the scope of this article. The racks which carry the cables between the various pieces of apparatus are made of strap and angle-iron and are carried overhead.

As a very large number of cables are required, all of which must be brought out in a certain consecutive order at both ends, the design of the racks and the arrangement of the cables demand careful forethought. An example of cable work is shown in Fig. 3. This is the rack carrying the multiple cables from the intermediate distributing frame at Holborn Exchange.

The arrangement of the power apparatus is shown in Fig. 2. The motor-dynamos for charging the battery are in duplicate as are also the machines for providing 15-cycle alternating current for ringing purposes. If possible, there should be two distinct sources of power for driving the charging machines, and the ringing motor-generators are driven generally one from the main supply and the other from the battery.

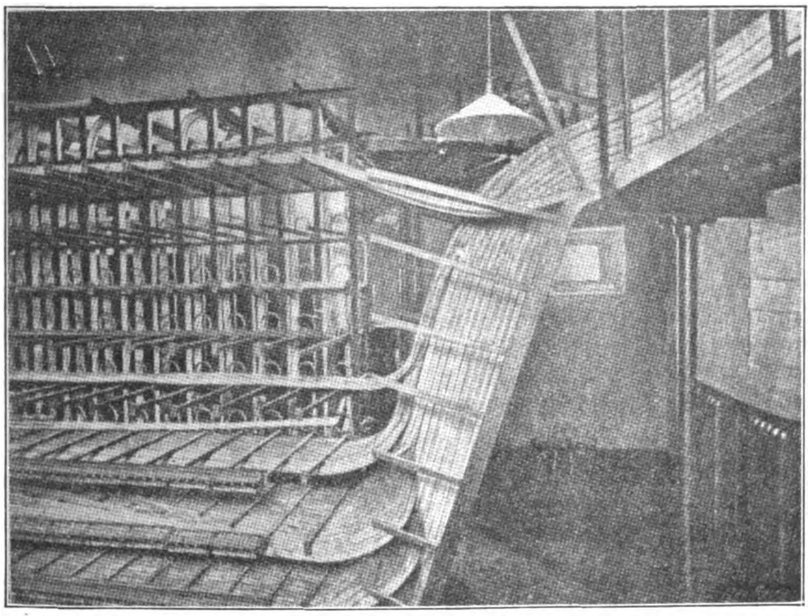


Fig. 3.—Holborn Exchange, I. D. Frame and Cable Rack.

The accumulator room contains the main 11-cell battery and the smaller 4 cell battery, which acts as a booster for the service registers—i. e., call-recording meters. The main battery should be provided with sufficient plates to hold a two day's load for the first three or four years' life of the exchange, and the tanks with room enough to take plates for the ultimate capacity of the exchange.

The power apparatus is generally so designed that one of the charging machines, running for two or three hours in the morning and afternoon at the peaks of the day load, keeps the cells full, besides which they are given a weekly "milking" to keep them in good condition.

(*To be continued.*)

A public conference will be held in Chicago at an early date between the traction interests, the committee on local transportation and the Mayor of that city, with a view to ascertaining a basis for the purchase of all of Chicago's traction lines.

A NEW USE FOR ELECTRICITY.

(From the New York Times.)

In conversation yesterday, a practical electrician who at one time acted as selling agent for a firm manufacturing electrical supplies, including incandescent lamps, disclosed "a trick of the trade" which, though it has some slightly dubious aspects, is certainly interesting and, to us at least, entirely novel. What he said was that while "on the road" in winter he was often obliged to pass the nights in hotels where, though most of the "modern improvements" were present, the bedrooms were usually very cold and the sheets often very damp. When it was a hotel that had electric lights he materially mitigated these woes by extracting from his "grip" a 32 candle lamp, equipped with insulated wires long enough to run from the bed to the nearest fixture, and ending in a "plug" that would take the place of a lamp destined for illuminating purposes. When ready for retirement he would remove the lamp, usually a small one, attach his own big one, and, with the latter for companion, seek the seclusion of the icy sheets. They never remained icy long, he declared, for a 32-candle lamp gives out a considerable amount of heat, mild and continuous. In the circumstances, this would obviously be a simple and efficient expedient, although we have more than a suspicion that the hotel keepers would not regard it with approval and we have more than half a suspicion that practice of the plan would be attended with some danger of accidents of several kinds. Shoved well down towards the foot of the bed, the light of the lamp would be no annoyance, while it would make no trouble as long as the insulation remained perfect and no unguarded movement with a bony heel shattered the fragile globe. That once broken, however, there would be an explosion that would at least give a somewhat painful start to the lamp's bedfellow and other mishaps might follow, possibly to the imperiling of the whole house. That is a question for the experts to decide, and as the expert who made the revelation was not afraid to try the experiment, presumably the peril is not excessive. At any rate the idea is a queer one, and the opportunities for exploiting it, if it is of any value, are not confined to hotels in the hinterland.

ANCHORING POLE LINES.

It is absolutely essential that every pole line should be properly guyed. To accomplish this very many street railway, telephone and electric light companies are making use of what is known as the Stombaugh guy anchors, manufactured by W. N. Matthews & Bro., 219 North Second street, St. Louis, Mo.

Some idea of the holding power of these anchors may be had from interesting tests made by Prof. R. C. Carpenter of Sibley College, Cornell University. Referring to the matter, he says:

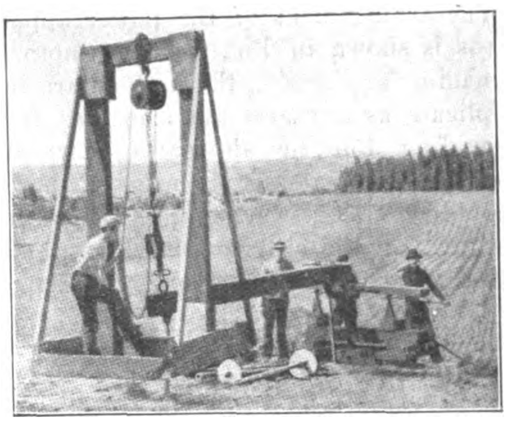
"Nearly all the important pole lines need lateral support, which is best given the poles by attaching guy wires to some suitable anchorage. Various forms of anchors have been used, varying from bars of iron driven in the ground, flat plates buried some distance, pieces of trees, cross-ties as 'dead-men,' and parts of poles as stubs, to complicated and expensive forms. In many cases the lateral pull on poles, due to the weight of the wires, wind stresses, etc., is of such an amount that unless the pole was thoroughly guyed laterally to some anchor, it would not maintain its position.

"During the past few months, the writer had an opportunity of investigating the holding power of a simple anchor, the results of which are believed to be of considerable general interest, as this anchor can be placed in the ground without any digging and will hold an enormous strain.

"The anchors to which I refer are termed after the inventor, the 'Stombaugh Guy Anchor.' They are made of various sizes and consist in each case of one full helix or screw thread of cast-iron, which is attached either to a long iron bar or to a guy wire, as desired. In general, the anchors are quickly and readily inserted in the ground.

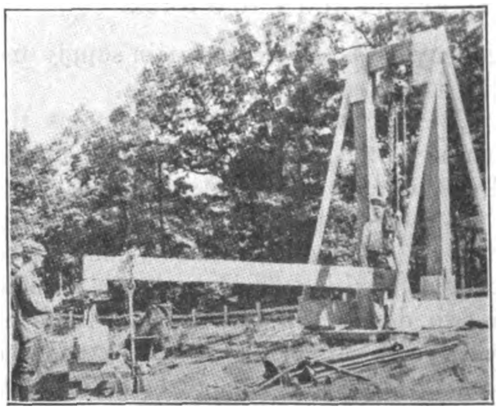
"Before making the tests, the writer considerably underrated the holding power of these anchors and was much astonished to find the magnitude of the resistance which they offered.

"The anchors were inserted in both sandy and clay soil, a suitable location being selected near the University. For the purpose of drawing the anchors from the ground, a dynamometer was arranged, which consisted substantially of a long wooden lever, one end of which was supported on rolling knife edges by a cross bar, which could be raised or lowered by jack screws; the other end was connected to a recording dynamometer, which could be raised or lowered by chain blocks. The anchor was attached to a rolling knife edge by a chain yoke connected to the eye of the anchor, so as to give a mechanical advantage of eight to one to the arm of the lever connected to the registering dynamometer. The reading of the dynamometer, multiplied by a constant factor, gave the holding power of the anchor. During the operation of testing, the long horizontal lever was kept level by raising both ends at the same rate. The arrangement for testing, as described, is very clearly shown in the accompanying illustrations.



SHOWING TEST IN SAND.

"During the tests, a slight movement of the anchor was always obtained before the maximum resistance was reached. After a movement which varied from ½ inch to 2 inches, the resistance fell off very rapidly. The holding power in clay was essentially greater than that in sand when the average of all cases are considered, the resistance being from 15 to 20 per cent. greater, but the range of testing could not, on account of conditions, be extended so far.



SHOWING TEST IN CLAY.

"The anchors were in every case pulled up very shortly after being inserted in the ground, so that it is extremely probable that the results of the tests are considerably less than would be experienced in practical use after the ground had settled.

"By comparison of the various results, it was found that the resistance of the anchors in sandy ground can be expressed very closely by the formula:

$$R = 100\,D\,H^2$$

in which R is the resistance offered by the anchor, in pounds; D is the diameter of the helix of the anchor, in inches; H is the depth of the helix, in feet, from the surface. The resistance for clay ground would probably be 20 per cent. more.

"As an example: A 10-inch anchor should have a holding power, in sandy ground, when 3 feet deep, of 100 × 10 × 9 = 9,000 pounds. This was less than was found with an anchor of this size. In a similar way, the 12-inch anchor, 4 feet in the ground, should have a holding power equal to 100 × 12 × 16 = 19,200 pounds. In an actual test, the anchor in this condition resisted 18,400 pounds. This was about the only case found when the holding power of the anchor was less than would be given by the formula. For these reasons, the formula is believed to be a safe one, especially when it is considered that the resisting power of the anchors will be increased after they have remained sufficiently long for the ground to consolidate.

"Taking all in all, the test gave some valuable data as to the holding of ground anchors, and indicated that great resistance can be secured by the use of simple helix form of anchors."

* * *

Municipal Electricians' Convention.

The tenth annual convention of the International Association of Municipal Electricians will be held in Erie, Pa., August 29, 30 and 31. At this meeting will be presented the following papers:

"Electrical Induction, Its Effects and the Application of Methods Used to Counteract It."

"Advisability or Inadvisability of Fusing Fire and Police Telegraph Boxes."

"Suggested Improvements in Fire Alarm Telegraphs."

"Underground Construction."

"The Necessity of a Rigid Inspection by the Municipality."

"Electric Light Engineering."

"Electric Light Plants."

These papers have been assigned to men who are thoroughly conversant with the subjects selected.

* * *

Dynamo Tender Wanted.

The United States Civil Service Commission announces an examination at San Francisco, Los Angeles, Fresno and Marysville, Cal., and Reno, Nev., on May 3, for dynamo tender. There is a vacancy at this time in the quartermaster's department at large, Presidio of

San Francisco, at $780 per annum. Age limit, 20 years or over on the date of examination. Apply to the United States Civil Service Commission, Washington, D. C., for application form 1,093, which should be properly executed and filed with the Commission at Washington.

Shell Type Transformers for High Voltages.

Editor Electricity.

Sir: We note in Mr. A. Frederick Collins' article on "High Potential Apparatus for Wireless Telegraphy," in your issue of April 12, he makes the statement that the transformer usually employed for wireless telegraphy is known as the core type. This broad statement is apt to be very misleading, inasmuch as the shell type transformers have been wound for 20,000 volts and very successfully used by the Government and leading wireless telegraph companies for some time, so that experience has shown that carefully designed shell type transformers can be built for high voltages fully as well as any core type transformers. Yours truly,

Edward A. Wagner.

Fort Wayne, Ind., April 19, 1905.

"American Exporter's" Compliments.

Electricity Newspaper Company:

Gentlemen: Please change the address of the "American Exporter" from Bennett Building to 120 Liberty street, New York City.

Let me take this opportunity to compliment you on the appearance and high grade of Electricity. Our editorial department would regard it as a misfortune to miss a single issue.

Very truly yours,

Edgar Allen Forbes,
Managing Editor.

Proposals Invited.

Sealed proposals are being invited until May 3 for furnishing and installing interior and exterior electric wiring and fixtures, and supplying current at Fort Brady, Mich., for one year, with privilege of renewal. Information will be furnished on application to Lieut. C. S. Hoffman, Fort Brady, Mich.

The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until May 9 for furnishing the Boston, New York and other Eastern Navy Yards with the following: Schedule 197, generating sets, magnet wire, slate slabs, conduit fittings, thermostat springs, etc.; schedule 198, motors, etc., batteries. Blank proposals will be furnished on application to the Navy pay office in New York or to the Bureau. Applicants should designate by number the schedules desired.

SOCIETY NEWS.

New York Electrical Society.

The 250th meeting of the New York Electrical Society will be held at 19 West 44th street, Wednesday, April 26, at 8 P.M. Mr. N. J. Neall will lecture on "Lightning Protection for High-Voltage Circuits." The lecture will be a resume of the development of lightning protection apparatus in America and abroad. A description will be given of the problems, their scientific character and bearing on the important question of lightning protection for high-voltage circuits, with a presentation of the favorable way in which these problems may be solved.

American Institute of Electrical Engineers.

The New York meeting of the Institute will be held at 154 West 57th street on Friday, April 28. Instruments and measurements will be discussed, the announced papers being as follows: "Polyphase Metering," by Prof. J. D. Nies of Lewis Institute, Chicago; "Notes on the Use of Instruments on Switchboards," by F. P. Cox of the General Electric Company, Lynn, Mass.; "The Oscillograph and its Uses," by Louis T. Robinson of the General Electric Company, Schenectady, N. Y., and "Maintenance of Meters," by W. J. Mowbray of the Brooklyn Edison Company.

PERSONAL MENTION.

Mr. John M. Mack has resigned as president of the Keystone Telephone Company of Philadelphia and Jacob E. Ridgeway has been chosen his successor.

Mr. Wilbur B. Driver, of Newark, N. J., has disposed of his interest in the Driver-Harris Wire Company and resigned as president of that company.

The Allis-Chalmers Company to Remove its Offices.

After May 1, 1905, the general offices of the Allis-Chalmers Company will be removed from the New York Life Building, Chicago, and will be located at Reliance Works, Milwaukee, Wis., which will hereafter be the headquarters of the vice-president and general manager, comptroller, assistant treasurer, office counsel, accounting and credit departments and also managers of power, pumping engine, mining and crushing machinery, flour mill and saw mill departments. The Chicago district sales office of the company, including that of the electrical department (the Bullock Electric Manufacturing Company) will also be removed from the New York Life Building and will be located in the First National Bank Building, Chicago.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED APRIL 18, 1905.

Electric Railways and Appliances.

787,527. Trolley-Retriever. Francis M. Miller, Arcadia, Ind. Filed Feb 2, 1905.

787,595. Electric Train-Signal. Albert W. Sullivan and William Renshaw, Chicago, Ill. Filed Aug. 5, 1904.

787,684. Trolley. Louis Leuenberger, Van Ness, N. Y. Filed Jan. 28, 1905.

787 810. Trolley-Pole Catcher. John H. Walker, Lexington, Ky. Filed June 6, 1904.

787,827. Electrically-Controlled Railway-Switch. Robert V. Cheatham, Louisville, Ky., assignor to the Cheatham Electric Switching Device Company, same place. Filed Aug. 9 1904.

787,856 Switch for Suspended Electric Railways Rudolf Pfaffenbach, Leipsic, and Hermann Muller, Leipsic-Gohlis, Germany. Original application filed Jan. 13, 1904. Divided and this application filed Oct. 29, 1904.

Electric Lights and Appliances.

787,428. Incandescent Electric Lamp. Frank H. Blackburn, Fostoria, O., assignor to the National Electric Lamp Company, Cleveland, O. Filed Jan. 6, 1904.

Electrical Machinery and Apparatus.

787,653. Electrical Stop-Motion Mechanism for Textile Machinery. Joseph B. Whitney, New York City. Filed June 30, 1903.

787,722. Motor Controlling and Regulating Device. Otto C. Britsch, New York City, assignor to David Wald, same place. Filed Aug. 31, 1903.

787,738. Motor-Starting Device. Arthur C. Eastwood, Cleveland, O. Filed Sept. 9, 1904.

787,820. Insulation for Electric Conductors. Lawrence E. Barringer, Schenectady N. Y., assignor to the General Electric Company. Filed Jan. 30, 1905.

Telephones and Telephone Apparatus.

787,361. Telephone-Transmitter. John Erickson, Chicago, Ill., assignor to the Strowger Automatic Telephone Exchange. Filed May 4, 1903. Renewed Oct. 3, 1904.

787,386. Support for Telephone-Receivers. Eldridge H. Little, Oskaloosa Ia. Filed Aug. 24, 1904.

787,507. Automatic Annunciator-Restorer. James I. Gemmill, Cleveland, O., assignor to the Gemmill Telephone & Manufacturing Company, Orrville, O. Filed Dec. 22, 1902.

787,583. Telephone Receiver. Charles T. Mason Sumter, S. C., assignor to the Sumter Telephone Manufacturing Company. Filed Feb. 27, 1905.

787,610. Telephone-Transmitter. Henry P. Clausen, Chicago, Ill., assignor to the American Electric Telephone Company. Filed Aug. 19, 1901.

787,879. Telephone Call or Ringer. Charles E. Egan Durham, N. C. Filed Aug. 13 1902.

Miscellaneous.

787,371. Lightning-Arrester. Lara M. Gates, Charlton, Ia. Filed Aug. 16, 1904.

787,393. Signal System and Apparatus Therefor. Frank P. J. Patenall and George H. Dryden, Baltimore, Md. Filed Jan. 23, 1905.

787,412. Art of Transmitting Electrical Energy through the Natural Mediums. Nikola Tesla, New York City. Filed May 16, 1900 Renewed June 17, 1902.

787,419. Electric Block-Signal. Walter Williams, Wadesville, Ind. Filed Oct 1, 1904.

787,442. Insulator for Electric Wires. Samuel B. Flynt and Leaman A. Maiden, Meridian, Miss. Filed Aug. 1, 1904.

787,561. Electrostatic Apparatus. Eugene W. Caldwell, New York City. Filed Feb 3 1905.

787,608. Printing-Telegraph. John C. Barclay, New York City. Filed July 9, 1904.

787,658. Induction-Coil. John A. Baker, Seguin, Tex. Filed June 13, 1904.

787,707. Electric Tool-Driver. William F. Wagner, New York City, assignor to the American Inventions Company. Filed Dec. 7, 1904.

787,715-716 Battery. William C. Banks, New York City. Filed Oct. 20 and 22 1904.

787,780. Wireless Telegraphic System. Walter W. Massie, Providence, R. I. Filed Nov. 1, 1904.

THE TELEPHONE WORLD.

Receiver for Telephone Company.

News from Trenton, N. J., states that Edwin Robert Walker, of that city, has been appointed receiver for the State Telephone Company by Vice-Chancellor Bergen. The application was made by J. Pratt Cramer. The company has a line running from Trenton to Bound Brook, and one from Bound Brook to Jersey City, consisting of wires and poles on the Lehigh Valley Railroad Company's right of way. The company has no local system in any of these cities.

A Trenton, N. J., dispatch says that "an arrest on the charge of fraud has followed the appointment of a receiver for the State Telephone Company of New Jersey, which formerly issued $1,000,000 bonds and put up wires from Trenton to Jersey City, but never installed any service."

The People's Telephone Company, of Fall River, will extend its line from Fall River Mills, Cal., through Burney Valley to Montgomery Creek, down Oak Run to Millville, and then go to Redding by way of Palo Cedro. Bella Vista may also be included. The farmers of Oak Run are anxious to have the line go through and will lend financial assistance for its construction. This will mean the initiation of direct communication from Redding to Fall River Mills without any transfer of messages, and will be of great benefit to the public in general.

The Federal Telephone Company has notified its patrons and the borough officials at East McKeesport, Pa., that it intends to retire from business. The company asks for the repeal of the company's franchise in the borough and the surrender of its bond. The borough council will refuse to surrender the charter until a sufficient amount of money is deposited to defray expenses connected with legislation necessary.

At present telephone activity is very noticeable in the villages of Shortsville and Manchester, N. Y., and the surrounding country, and more telephones have been ordered than can be installed for some time to come. The Red Jacket Company, located in Shortsville, has a large patronage through both villages, and has several miles of rural service all through that vicinity. It is extending its lines daily, and is expecting to build seven miles of new line at once.

The Cecil Farmers' Telephone Company, of Elkton, incorporated by the last Legislature of Maryland, is building lines in the upper section of Cecil County. At a recent meeting of the stockholders of the company it was decided to increase the capital stock from $5,000 to $25,000.

A long distance telephone line from Decatur to Birmingham, Ala., is being constructed, a distance of 87 miles.

The Orange County, N. Y., Telephone Company is understood to be negotiating for the New Hampton & Bloomingburg telephone lines.

A dispatch from Vienna, Austria, states that automatic telephones have just been introduced among a limited number of subscribers in that city.

Two Nebraska Independent Companies Increase Capital.

The Platte County Independent Telephone Company has amended its articles of incorporation increasing its capital stock to the authorized limit of $40,000.

The Hastings Independent Telephone Company has increased its capital stock to $300,000 to provide for an issue of $150,000 of preferred stock, to draw 6 per cent. dividends annually.

The Ellis County Independent Telephone Company has now direct connection with Hillsboro, Waco, Houston, Austin, San Antonio and other South Texas points. A long distance line connecting Waxahachie with Waco was completed recently. The Independent has had connection with Corsicana two or three years. Material has been purchased for the construction of a line between Waxahachie and Fort Worth. When this line is built the long distance service will then be complete to St. Louis. This company has made several unsuccessful efforts to get into Dallas, and it yet hopes to establish a system in that city within the next year or two.

The Diamond State Telephone Company has begun the erection of a line between Elkton and Cowentown, Md. The company has lines running to almost every town and village in Cecil County, and has about 500 subscribers. Recently the line has been rebuilt between Elkton and Rising Sun and Cherry Hill and Elkton.

The Nicholas Telephone Selector Company, of Rochester, N. Y., has been formed to deal in electrical apparatus, with a capital of $10,000. The incorporators are Willard C. Rich, G. W. Rich and William H. Boutell, of Rochester; Charles E. Nicholas, Columbus, O.

An automatic telephone service, costing thousands of dollars, is being installed throughout the Solvay Process Works, and in the homes of the officers and employes in authority in various parts of Solvay and Geddes, N. Y.

According to the franchise given by the corporation board to the telephone company in Mohawk, N. Y., the rates can in no case be advanced from present prices, $12 for dwellings and $24 for business places, as they were said to be permanent when the franchise was granted

The Glen Telephone Company will on May 1 raise the rates of 'phones in Fonda, N. Y. All business 'phones will be $2 per month instead of $1.50 as at present. The price of the residence 'phones will not be increased, but they will only have the privilege of talking to residents in Fonda and Fultonville.

A farmers' mutual telephone company has been organized to furnish telephone service in Oceana County, Mich., at cost. The officers of the new company are: President, C. W. Taylor; secretary and treasurer, Roger Southwick; directors: Lucius Slocum and Kim Croff.

A stock company is being organized in Montrose, Miss., to build an Independent telephone system from Newton to Bay Spring, taking in Garlandsville, Baxter and Montrose.

Mortgage for $15,000,000.

A corporation mortgage for $15,000,000 has been given by the Independent Securities Company to the Security Trust Company, of Rochester, N. Y. The corporation has its home in Utica and includes nearly all the Independent companies in this State.

D. A. Reynolds, vice-president and manager of the State Line Telephone Company, has organized an Independent company at Peekskill, N. Y., to compete with the Hudson River Telephone Company. The new company will have its line in operation by July 1 and will reduce the price of 'phones to $18 per year. The company will have special fire and police calls.

The Arkansas City, Kan., Commercial Club has started a fight on the Missouri & Kansas and the Pioneer Telephone Companies, with the object of having the two companies, which are now understood to be under the same management, consolidate their exchanges, and relieve the patrons from the necessity of paying for two telephones, and also for the purpose of improving the service.

Citizens of Bloserville, Pa., and vicinity, have organized a telephone company, which will be known as the Bloserville Telephone Company. The company will begin the construction of a line from that place to Newville, where it will connect with the United Telephone & Telegraph (Home) lines.

The Oklahoma Rural Telephone Company, operating seven rural lines, and the Pioneer Telephone Company at Enid, Okla., have at last settled their differences and a contract has been signed whereby the patrons of the two systems are to have free exchange over all lines.

Gloversville, N. Y., is to have a new Independent telephone company. A canvass for subscribers was lately commenced, and it is the intention of the new company to form an organization and install a modern plant for the cities of Johnstown and Gloversville. LeRoy W. Stanton, an electrical telephone engineer, of Cleveland, O., is promoting the project.

The Providence, R. I., Telephone Company is to erect a telephone exchange at Narragansett Pier, and it is expected that it will be finished in time for the convenience of the summer patrons. The building is to be two stories high and a common battery board is to be installed.

Arrangements have been made by the New England Telephone Company, to extend its service at reduced rates for the benefit of the farmers at Amherst, Mass.

Telephone Incorporations.

The Danby Telephone Company, Danby, N. Y. Capital stock, $7,200. Incorporators: J. E. Black, Charles E. Bruce, C. F. Denman, all of Danbury.

The Watkins Telephone Company, Watkins, Minn. Capital stock, $10,000. Iocorporators: H. J, Wartman, J. P. Olson, H. J. Kainer and C. C. Vitrance, all of Watkins.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Bamberg, S. C.—The citizens have voted to grant a 30-year franchise to Messrs. Howell & Jordan for a waterworks system and electric lights.

Bellefontaine, O.—The citizens have voted in favor of issuing $50,000 in bonds for improving the municipal electric lighting plant.

Cleveland, O.—The People's Electric Lighting & Power Company, of this city, has been incorporated by H. T. Emerson, William Brodie and others. Its capital stock is $10,000.

Detroit, Mich.—At a recent special meeting of the council the by-law to raise $30,000 for the rebuilding of the electric plant was passed provisionally, and will be voted on along with the other by-laws May 12.

Douglas, Ga.—Superintendent Putzel is rushing the work of wiring the streets and buildings, and within a short time this city will be fully equipped with electric lights.

East Hampton, Mass.—The directors of the East Hampton Gas Company will install a new electric lighting plant here.

Far Rockaway, N. Y.—The work of installing electric lights in the Wave Crest section will begin in a few days.

Goldendale, Wash.—H. W. Fellows, an electrical engineer of Spokane, has applied to this city council for an electric light franchise.

Hampton, Ia.—L. A. Little, of this city, has traded a farm of 1,200 acres for the electric lighting plant at Missouri Valley, the amount involved being $18,000.

High Point, N. C.—The High Point Ice & Fuel Company, with a capital of $125,000, has been incorporated by Charles Behee and W. G. Burnett, of Atlanta, and Westcott Robertson, of this place, to conduct a general electric lighting business.

Kelso, Wash.—The town council has granted a franchise for electric lighting to the Kelso Water & Light Company

Madison, Mo.—The election to vote on the issuance of bonds to the amount of $5,000, for the erection of an electric light plant, was lately carried.

Melrose, Minn.—A special election will be held April 29 to decide whether or not to issue electric light and water bonds.

Miamisburg, O.—The board of public affairs has instructed the clerk to advertise for bids for the construction of a new electric light plant in this city.

Newark, N. J.—The New Jersey Beck Electric Lighting Company has been incorporated here with a capital of $125,000. The incorporators are Charles A. Woodruff, Thomas J. Butler and Eli Teeter.

Paterson, N. J.—The Paterson Electric Light, Heat & Power Company has been incorporated with a capital stock of $500,000. The new company will be the most formidable rival of the Lighting Trust in this State, as it is the intention of the stockholders to extend the business outside of this city.

Pine Bluff, Ark.—The St. Louis Southwestern Railroad Company will install an electric lighting plant in its shops. Harry H. Sanborn, an expert electrician of St. Louis, will superintend the work.

Sanborn, Minn.—The citizens have voted the issuance of $6,000 bonds to install an electric light plant.

Shelbyville, Tenn.—The Legislature has passed an act authorizing the board of mayor and aldermen of this place to issue bonds aggregating $40,000 to buy an electric light plant and waterworks system.

Walker, Minn.—The citizens have voted to issue bonds for an electric light plant.

Wasco, Ore.—The city council has ordered a special election to be held May 10 to vote on the question of issuing bonds in the sum of $23,000, to be used for the installation of an electric light plant, sewerage and water system.

Williston, N. D.—The citizens have voted to bond this city in the sum of $27,500, for the purpose of constructing a system of waterworks and an electric lighting plant.

Wisner, Neb.—A special election is to be called to vote on the proposition of issuing $9,000 worth of bonds to construct an electric light plant.

STREET RAILWAYS.

Albert Lea, Minn.—The Collins Construction Company is now preparing plans for a trolley line to run from this city to St. Cloud.

Alexandria, La.—A largely attended meeting of citizens was held here a short time ago to listen to the proposal of T. G. Bush, of Mobile, and G. N. Borde, of New Orleans, to establish an electric line. The promoters were assured of a franchise and assistance on the part of the citizens.

Ashland, Va.—The electric car line between Richmond and this city, is now an assured fact.

Bunker Hill, Ill.—There has been organized here the St. Louis, Bunker Hill & Eastern Traction Company, with the purpose of building and operating an electric line from East Alton to Litchfield. J. H. Belt, Jr., is president and W. B. Powell, secretary.

Frederick, Md.—The Maryland Construction Company, a corporation formed for the purpose of constructing an electric railway between Baltimore and this city, has acquired 60 acres of land near the Monocacy River near Ceresville, a couple of miles north of here. It is understood that the land is to be used as a site for the power plant of the railway.

Gallatin, Tenn.—The friends of the proposed electric railway from this city to the Cumberland River and Castalian Springs held a recent meeting with 15 additional advocates of the enterprise, to form a plan to immediately organize and elect officers for the purpose of acquiring right of way and making a survey of the route over which the line will run. Temporary officers have been elected as follows: Charles A. Whitesides, president; W. G. Schamberger, vice-president; William Hall, treasurer, and E. O. Buchanan, secretary; committee on right of way, C. H. Fiddler, E. E. Chrisman and J W. Carmichael.

Greenfield, Ind.—A "cross-country" electric railway is proposed by a company organized to build from Fortville to Shelbyville, through Maxwell to this place and Fountaintown. The promoters are M. B. Walker, of Fortville; J. M. McCreery, of Indianapolis; Arthur Jones, of Alexandria; Edwin Downey, of Anderson, and W. A. Hough, of Greenfield. It is said that the line has already been surveyed from Fortville to Greenfield.

Sayre, Pa.—The council has voted to grant the request of the Sayre & South Waverly Electric Railroad Company for a franchise and privilege to build an electric road through the borough.

Ticonderoga, N. Y.—There is a movement in progress for the construction of an electric railway in this vicinity. Capitalists of Troy, N. Y., and Vermont, are said to be considering the plan. The proposed road, it is said, will be 14 miles long, running from Hague to Baldwin and hence to Addison Junction and connecting with the Rutland Railroad system. It is said that the ultimate extremity of the road would be at the end of Lake George, where connection with the Hudson Valley Road would be made.

Walla Walla, Wash.—There is an electric line proposed that will connect this city with the Columbia River at Wallula.

Webster City, Ia.—Lester Gailey, an Eastern promoter, is in this city to interest local business men and capitalists in a proposed electric line from Fort Dodge to Webster City and thence south to Des Moines. He roughly estimates the cost of such a line at $20,000 per mile, including all equipment.

POWER PLANTS.

Jackson, Mich.—The Commonwealth Power Company is preparing plans for a $100,000 power plant to be built here.

Williamsport, Pa.—An official of the combined electric companies of this city lately made the statement that the proposed big power plant will be built during the coming summer.

York, Pa.—The much talked of electric power plant on the Susquehanna River, near McCalls's Ferry, York County, looks like an assured fact, since the New York capitalists have agreed to furnish the money when a favorable report has been made by the engineers. It is said that $10,000,000 will be forthcoming if the engineers make a favorable report.

BIDS WANTED.

Binghamton, N. Y.—Sealed bids will be received by the city clerk until May 8 for lighting the city streets with electricity.

Joplin, Mo.—The board of public works of this city will advertise for bids for the construction of betterments and the addition of equipment to the city lighting plant; the capacity is to be more than doubled. Improvements will cost $30,000.

Port Arthur, Ont.—Sealed bids will be received until May 5 by the chairman of the electric railway and light commissioners for the purchase of the following electrical machinery: One 150 hp. Wheelock compound condensing engine; one 80 hp. boiler, shafting, pulleys and belting; one 500 volt. 45 kw. railway generator; one 60 kw. 2,000 volt, 125 cycle alternator, with all necessary switchboard and attachments. J. McTeigell, secretary of the electric railway and light commissioners.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15@15⅛c.; Lake 15⅛@15¼c.; casting, 14¾@14⅞c.

The New York, New Haven & Hartford Railroad Company has bought the Suffield (Mass.) Street Railway for $75,000.

The regular quarterly dividend of 2 per cent., declared by the directors of the Chicago Edison Company, will be payable May 1.

A dispatch from Schenectady says the pay roll of the General Electric Company's plant in that city is now the largest in the history of the company.

The Providence & Burrillville (R. I.) Street Railway Company has issued $750,000 five per cent. 20-year bonds and will double-track 20 miles of main line.

A reorganization committee of the Eastern Ohio Traction Company has requested holders to deposit their securities for the purpose of effecting a reorganization.

The United Metals Selling Company has made a reduction of ⅛ cent in the price of refined copper, which is the first change that has been made for several months.

The Hewitt Motor Company of New York was recently incorporated at Albany with a capital of $100,000. The directors are E. R. Hewitt, Erskine Hewitt and C. O. Snyder, New York.

It is expected that the bonds of the Keystone Telephone Company of Philadelphia, which are being underwritten, will be allotted by May 1, and all arrangements completed for placing them.

The American Light & Traction Company has declared the regular quarterly dividend of 1½ per cent. on its preferred stock, and a second semi-annual dividend of 1½ per cent. on its common stock, both payable May 1.

Stone & Webster of Boston report a semi-annual dividend of $5 per share, payable May 15, on the capital stock of the Tampa Electric Company, to stock of record May 5. Books close May 4 and reopen May 16.

The New York State Board of Railroad Commissioners has authorized the Rochester Railway Company to increase its capital stock from $5,500,000 to $6,000,000. The increased capital is stated to be needed for new construction and reconstruction.

A special meeting of the stockholders of the Montreal Street Railway Company has been called for May 8 for the purpose of voting on a proposition to issue $1,000,000 of 4½ per cent. 20-year bonds, the proceeds of which are to be utilized for extensions, improvements, increased electrical power facilities, etc. The new bonds will be issued to stockholders at par. The present bonded indebtedness of the company amounts to $2,473,000, and the capital stock is $6,600,000.

It is reported in Wall Street that the annual report of the General Electric Company will not be as good as some people expected. Last year the profits of all manufacturing companies were smaller than the previous year, and, while the business of the General Electric Company was comparatively well maintained, prices were lower in many instances and business restricted, and this condition will be reflected in the annual report covering the last fiscal year. It is feared in some quarters that a trade contest with the Westinghouse Company and with the Allis-Chalmers Company (the latter having spent $3,000,000 in extending its plant to compete with both General Electric and Westinghouse), foreshadows still smaller profits in the future.

ELEOTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Apr. 24
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	205
Manhattan Elevated Railway	164¼
Metropolitan Street Railway	120
Metropolitan Securities	82¼
Ninth Avenue	197
Third Avenue	129
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	66
Brooklyn City Railway	240
New Orleans Railway	4¼
Public Service Corporation (New Jersey)	121
Philadelphia.	
Consolidated Traction of New Jersey	84
Philadelphia Traction	99⅞
Union Traction	60⅞
Boston.	
Boston Elevated	156¾
Massachusetts Electric Companies, com	20⅛
do. do. do. pref.	68
West End Street, com	97½
do. do. do. pref.	117
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	8⅛
do. do. pref.	45
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	16¼
do. pref.	60¼
Electric Boat, com	37
do. do. pref.	78
Electric Lead Reduction	⅛
Electric Vehicle, com	12⅛
do. do. pref.	20
Westinghouse, com	174
do. pref.	192
General Electric	180
Boston.	
Edison Electric Illuminating	255
General Electric	184⅛
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	165
National Carbon, com	62
do. do. pref.	114
Philadelphia.	
Electric Company of America	12¼
Electric Storage Battery, com	83
do. do. do. pref.	83
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	144
Western Telephone Company	18¼
New England Telephone Company	188⅛
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210¼
Mexican Telephone Company	1⅛
New York & New Jersey Telephone Company	172¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93⅛
Chicago Telephone Company	137¾
MISCELLANEOUS STOCKS.	
Otis Elevator Company	52
Consolidated Car Heating	64
Standard Underground Cable	200

Electrical Exchange Building.

TO RENT

Large Store and Basement

FRONTING ON

Liberty, Washington

—AND—

Cedar Streets.

About 5,000 square feet
and larger Basement.
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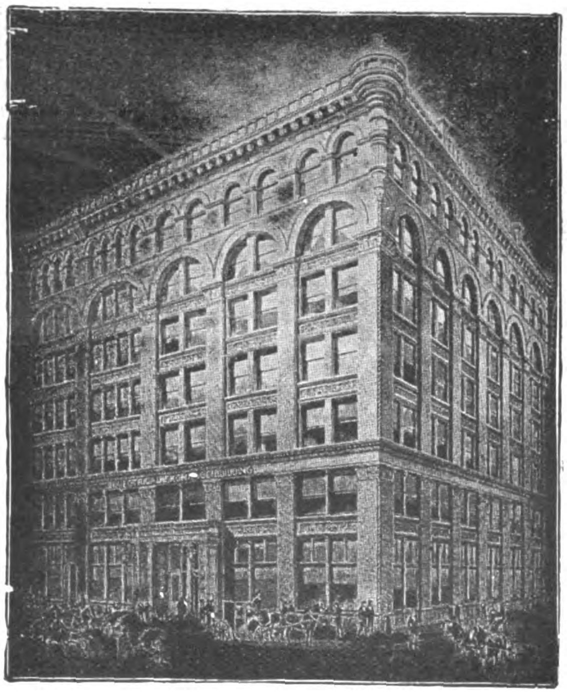

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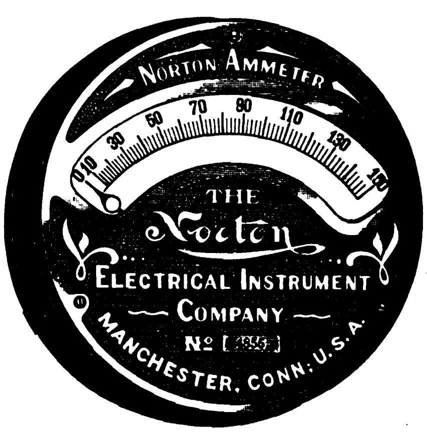
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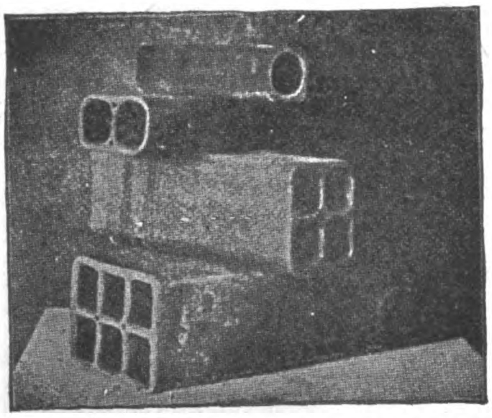

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EDITORIAL NOTES.

The General Electric's Annual Report.

The annual report of the General Electric Company was made public on Friday last, and it shows that the gross earnings of the company last year were about $2,500,000 less than the previous year and the orders received were $4,000,000 less.

The total profits of the company, less the debenture interest, but prior to the drastic writing off for depreciation of factory plants, patents, etc., were equal to 17.61 per cent. on the capital stock of $48,247,943, against 22.38 per cent. on the capital stock of $43,866,700 in the previous year. After all charges and writing off, the balance applicable to dividends on the $48,247,943 capital stock was equal to 12.35 per cent., as compared with 14.40 per cent, on $43,866,700 capital stock in the previous year.

Third Vice-President E. W. Rice, Jr., notes in detail in his report the engineering results of the year. He says that the commercial success of long distance transmission systems is generally recognized and the number of such undertakings has increased. One interesting instance of the constantly increasing number of applications of electric motors is that of the high-speed electrical motor centrifugal pump, which promises to replace the steam pump for supplying water to cities. This electric pump occupies about one-quarter the space, costs much less and is more efficient than the present steam pump. Mr. Rice says that the combined turbo-generator has such manifold advantages in economy, reliability, simplicity and low cost that it is certain to replace all other forms of steam engines in generating electricity. The new alternating current motor, he says, has been successfully employed on two tramways, and numbers of additional orders have been received. The report further says: "Our inventors have been actively at work for several years to discover more efficient and better methods of electric illumination than the present carbon arc and incandescent lamp. As a result, this last year we have introduced the 'magnetite' arc lamp, which gives a light equal to the present carbon arc with about one-half the consumption of energy, and have also made important improvements in the economy of the incandescent lamp."

Of the work of electrifying steam railroads, the report says:

"The electrical work of the New York Central Railroad has excited much interest among the officials of other railroads, and from the numerous inquiries and requests for plans and estimates which we receive, it is evident that we are entering upon a most interesting phase of electrical development in connection with steam railroads, and that it will not be many years before all suburban trains in the vicinity of our large cities will be operated by electric power."

President Coffin summarizes the report as follows: "While our total business was less in 1904 than in 1903 in money value, the number of contracts and orders was greater, resulting in more work for the organization."

* * *

Instructors in Engineering and the Carnegie Pension.

Philanthropy is the sublime art, and its benefactions have extended to the inner sanctum of academic life. Mr. Carnegie has made millions out of the technical knowledge of his colleagues and is spending them like an intellectual king. Neither is he neglecting, so to speak, his co-workers, their children or their children's children. To them he is offering the gift of knowledge, which leads to independence, and thus is intensifying the spirit of Americanism in its highest sense. And this gift of knowledge, laid at the door of every workman by the spread of great technical schools, is not to be the means of adding misfortune to the lives of those entrusted with the task of transmitting this knowledge. They have not been forgotten, they will not be forgotten, when old age and decrepitude lay weighted hands on their feeble forms. The new plan outlined and crystallized by the munificence of Mr. Carnegie will give them financial support in their declining years—and the links of reasoning which connect the labor of the pedagogue with the wealth of the steel king are readily made self-evident. A teacher of pure or applied science is fitting men for the task of earning a living in the world. The industralism so characteristic of American life calls for an unusual army of technicians. Gigantic schemes are projected whose pilots, captains, lieutenants and other workers must undertake purely technical responsibilities. Those whose early lives have been moulded by the influences of technical training occupy all positions from the bottom of the ladder to the top. In large or small electrical establishments this is emphatically true, and many large corporations devoted to the design and construction of electrical equipments request in their printed application blanks for positions, knowledge of what technical school the applicant is from. These graduates become the builders of great fortunes either for themselves or for others. They become the competitors of their own instructors, who might perchance find a better field in practical life for their talents than teaching. Mr. Carnegie owes his wealth to technical knowledge fundamentally, although the financial co-operation of great concerns lifted these great steel industries from the shadows of simple manufacturing life into the bright light of public observation. The preliminary school for industrialism is the technical school, and the protection afforded in their old age to the instructors thereof will drive away many of the disturbing worries presented by a review of the possibilities of the future.

A fund of $10,000,000, the interest of which at 5 per cent., or $500,000, with which to ease the last years of merited repose of our teachers in technical schools and colleges, rises before the mind's eye as a splendid act of exalted philanthropy.

Many of our teachers and professors of electricity who have yielded up their life's fiber in imparting instruction in this science will be benefited by this donation. With this provision in store for them their work will be rid of unpleasant thoughts of the future.

How strange it seems to know that the profession of teaching is poorly paid, so badly, in fact, that out of the small salary it yields it is not expected that the instructor can save enough to secure future independence. Millions are spent on magnificent temples of learning, but the power and brains that give them a name in the world remain as of old the recipients of barely a living. It has taken Carnegie, the man of heart and intellect, to recognize this fact.

* * *

Another Reduction in Telephone Rates.

The fight which has been waged for years against the exorbitant rates of the New York Telephone Company has not been barren of results. Beginning June 1 another reduction in rates will go into effect. The latest concession, however, only benefits a certain class of subscribers, namely, large establishments, such as hotels, brokers' offices, etc., or senders of more than 3,600 messages annually in Manhattan. The present rate for the above number of messages a year is $240 while the new rate will be $216.

As announced by an officer of the company the mileage charges for circuits connecting station of the premises to private branch exchanges, or for tie lines connecting one private branch exchange with another, which heretofore have ranged from $60 to $84 per mile, have been reduced to range from $48 to $60 per mile.

The charges for circuits crossing the North River (when used for connecting extension stations to a private branch exchange or for tie lines) which heretofore have ranged from $204 to $300 per circuit, have been reduced to range from $180 to $240 per circuit.

The charge for local messages from private branch exchanges in excess of 3,600 will be as heretofore, 4 cents each, or, when contracted for in advance, in lots of 400, $3 per hundred.

The charge for an auxiliary line and stations—i. e., a second line supplementing a direct line—which heretofore has been $48, has been reduced to $36 per year.

From this it will be seen that the monopoly has condescended to reduce its charges in this case from 5 to 10 per cent.

But allowing for the concessions already and about to be made there will be little danger of the company going into the hands of a receiver and it will not be necessary to omit declaring a dividend on its stock.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The annual meeting of the General Electric Company will be held in Schenectady, N. Y., May 9.

Mr. Marconi is at present in Cape Breton watching the progress of the construction of his new wireless station.

The Stevens bill presented to the New York Legislature Monday night provides for 75-cent gas and 10-cent kw.-hour electricity in New York, also adequate inspection of quality and pressure, the repeal of the law authorizing the formation of the lighting combine, and the creation of a State board to supervise all lighting, telephone, telegraph and transportation companies.

Mr. George F. Porter, master of transportation for the National Electric Light Association, has appointed Mr. Charles H. Hodginson, of the Boston Edison Company, to look after transportation matters in New England in connection with the coming convention at Denver-Colorado Springs, June 6 to 11.

The wages of the gatemen and guards in the employ of the Interborough Rapid Transit Company of New York have been advanced from 10 to 15 cents a day, according to the length of time they have been on the payrolls. The order went into effect May 1.

A cable dispatch from Berlin says the International Congress, called to celebrate the tenth anniversary of the discovery of the Roentgen ray and to collate the latest applications and developments, opened in that city on Sunday and will continue in session the greater part of this week. Prof. Roentgen is present. Among the Americans attending the Congress are Dr. Leonard of Philadelphia, Dr. George Kunz of New York, and Dr. Rudisjicinsky of Cedar Rapids, Ia.

The next meeting of the Chicago branch of the American Institute of Electrical Engineers will be held on May 23. Mr. J. R. Cravath will read a paper on "Light Electric Railways."

FARMING BY ELECTRICITY.

BY A. FREDERICK COLLINS.

That great peninsular stretching southward between the Adriatic Sea and the western part of the Mediterranean, and which is bounded on the north by the Alps, separating it from Austria and Switzerland and from France on the west by the Maritime Alps, is remarkable for the fertility of its soil and famous for its gigantic water powers.

For this reason Italy is a country teeming with agricultural interest and hydraulic power developments, the latter having in recent years been utilized extensively for the generation of electricity, and the fecundity of its soil is only excelled by its growth of hydro-electric plants.

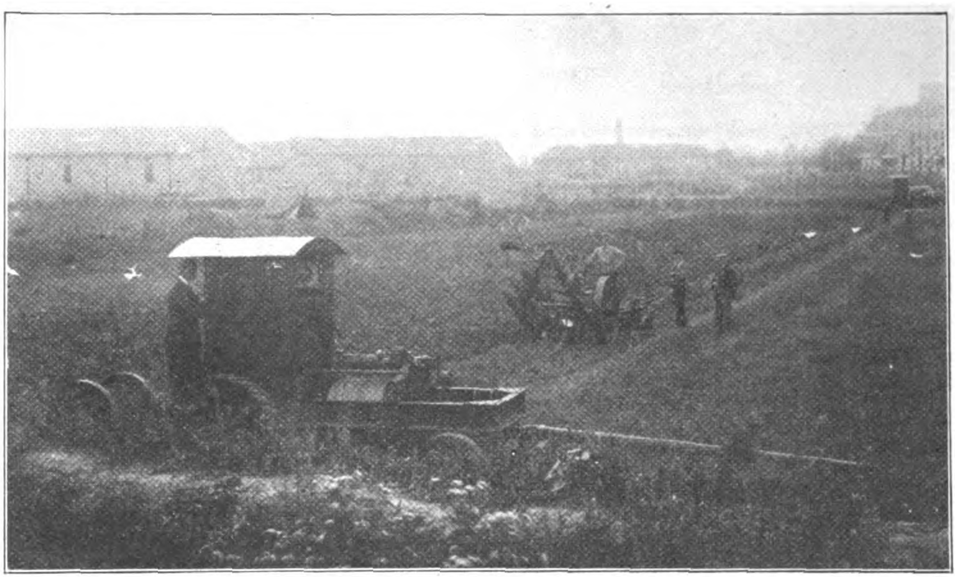
From these great hydro-electric central stations, located at the very head of natural sources of power, many thousand kilowatts are sent through overhead high-tension lines across the fertile fields, rendering feasible the application of electricity to agricultural pursuits easy of accomplisment and economical in its results.

Since hydro-electric power can be obtained at exceedingly low prices—much lower in fact than in the United States—it is evident that these domestic applications, which have practically just begun, shall in the immediate future be greatly extended, and even now manufacturers of farming machinery are designing and building special machinery for the utilization of electricity instead of animal and other tractive powers.

In Turin, the Societa Elettrotecnica Italiana, one of the most important companies building electrical machinery in Italy, has become deeply interested in this basic problem and is now developing a full line of farm machinery, the result thus far seeming to point to the final elimination of the ox and horse as a factor in the tillage of the soil. As the fundamental operation of turning up the soil has, where animal power was used, been the most tedious as well as requiring the largest expenditure of power in agriculture, the advent of any means to lighten the labor and decrease the expense must be hailed with interest.

On this primary and important work hinges to no small extent the products of the field. In England, Germany and America steam cultivating machinery is in extensive use; in the steam system gigantic plows that will turn from three to five furrows at a time are connected up to a traction engine which draws the implement from one end of the field to the other and then back again. While the plows are made so that they need not be turned around and the engine runs with equal facility in either direction, there is a considerable amount of time lost at either end in uncoupling the plow and manœuvring the engine.

Notwithstanding this untoward feature steam power in husbandry has proven of great value on large farms, for the agriculturist is made more or less independent of the seasons and is enabled to get in his seed at more nearly the proper time and to do away with a large number of horses, applying the food they would consume to more profitable places. Besides plows, harrows, cultivators, harvesters and other implements for quick work have been designed for operation by steam and have proven successful in every way in the countries where they have been used; but steam machinery is not very economical in a country where coal is expensive and labor and water power cheap.



Electrically-Operated Plow at Work.

The Societa Elettrotecnica Italiana has taken cognizance of the facts and in the electric plowing system devised by it has fully met the conditions, both agricultural and electrical, of that country alone, but there are many places in the far West of the United States where the same method could be used with excellent results, as, for instance, in the sun-baked but fertile valleys of Southern California.

The Italian system consists of two electric winches mounted on separate trucks and these, when the field is to be plowed, are placed opposite each other when they are connected together by means of a steel cable of small diameter. The plow used is of the Fowler type, similar to those employed for steam plowing, except that it is not quite so heavy, but it is balanced and made double and this is coupled to the transmission rope which is carried in either direction by means of winches.

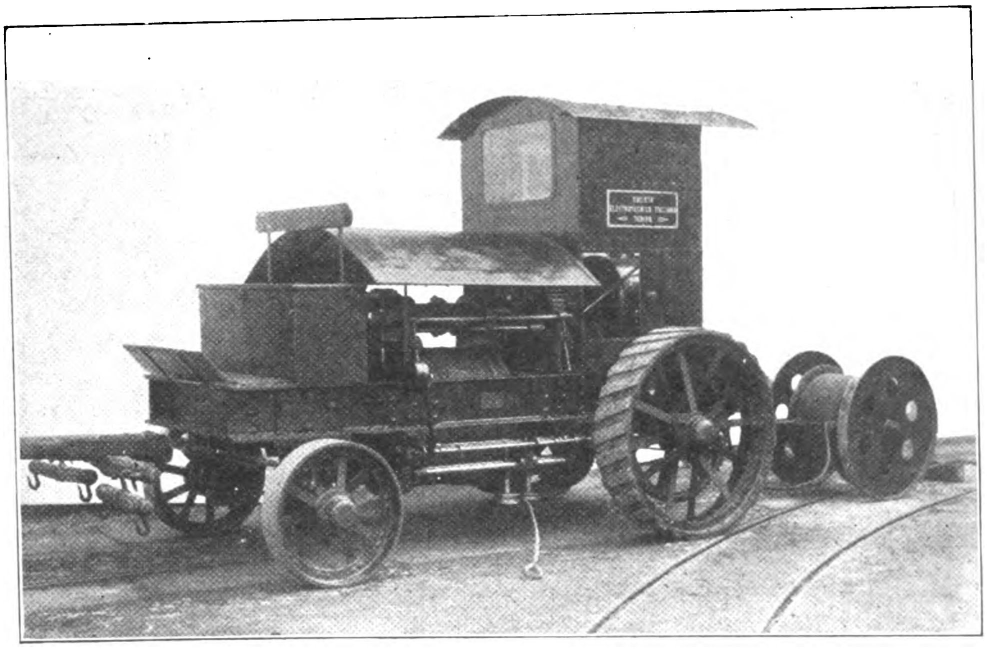
The winches are operated electrically by an induction motor which transmits its power to the drum of the winch-rollers through the medium of a reduction gear. The motor of each outfit is of 20 hp. and develops a cable speed of 50 meters when the plow is cutting furrows to a depth of 25 cm. By reducing the speed of this motor the depth of the furrow may be increased to 60 cm. (about 2 feet), which is the limit prescribed in that country.

To change the speed the winches are equipped with interchangable gears making it possible to run at 0.80, 1.20, 1.60 or 2 meters per second and in this way the most variable conditions of the soil are met. There are devices mounted on the truck for winding the rope on the drum evenly during the traction of the plow and for braking the drum at the moment of stopping.

There are also automatic arrangements for braking the current when the plow is at the end of the run so that the grossest carelessness of the employes cannot cause a collision of the plow and the winches. When the run is completed, the balance plow is instantly shifted and the opposite drum begins to do its work, carrying the plow back again. The trucks are equipped with small switchboards, carrying all the controlling apparatus necessary for the motor.

Though horses are employed to draw the trucks where any considerable distance is to be traversed, the trucks are arranged with wide traction wheels which are operated by the motor, so that it follows progressively and automatically the plow as the latter changes furrows.

The handling of the whole portable installation is very easy and the operation of propelling the plow through a length of furrow of 350 meters and getting the plow ready for the return trip consumes only about eight minutes. Therefore if it were possible to work without interruption at this speed and plow three furrows at a time it would require about four hours to plow one hectar (equal to about 2½ acres. This speed is more than eight times that which can be obtained by animal traction and the depth of the furrow is much greater, and naturally the plowing by means of the former is vastly superior to that of the latter.



Electric Winch Used in Plowing.

The current is conveyed to each of the two electric windlasses from the overhead transmission lines and a special system of movable contacts are connected to a flexible cable wound upon a reel and carried on wheels. These flexible conductors give the plow a wide latitude and hence the apparatus can be worked in any vicinity where current can be had.

A high-potential oil-insulated transformer is also provided to step down the voltage from the high tension lines to a value suitable for the local lines. The simplicity of all the individual devices which goes to make up the electromechanical units for the system of electrical plowing make it especially valuable, for the trucks are usually operated by ordinary workmen who are not at all skilled in the art. Another feature worthy of mention is that the different parts are easily get-at-able and this is important in a class of apparatus constantly exposed to the variations of the weather.

Again the same trucks can be used for many other purposes on the farm, as, for instance, in combination with harrows and harvesters, and during the winter they find a ready application for sawing wood, pumping water, churning, etc.

A pair of these winches can be kept almost constantly at work during the entire year on every farm of any considerable size to an advantage, and its economy can easily be calculated providing the two following factors are known—the price per kilowatt of electrical energy and the wages of three farm-hands, which of course vary in different countries and in the same country under dissimilar conditions.

* * *

THE ARNHEIM PARTY-LINE TELEPHONE SYSTEM.

A most ingenious development of the party-line telephone system has been worked out by Prof. Paul Arnheim and is now being placed on the market in England by the Berliner Telephone Manufacturing Company. By a party-line is meant a telephone line shared by several subscribers, and provision must be made for "selective ringing"—that is to say, for calling up any one of the subscribers without disturbing the others. On the postoffice and national telephone exchanges in this country this selective ringing is provided for by connecting the subscribers' bells either between the A line and earth or the B line and earth, and by giving the bells a "bias" for positive or negative currents, so that four subscribers may be placed on a party line if necessary without the introduction of a code of ringing signals. This has the disadvantage, however, that any subscriber can cut-in and listen to or take part in the conversation of another subscriber. The main object of the Arnheim system is to remove this defect without having recourse to the complicated "lock-out" systems which have been tried from time to time in the United States. Another object is to increase the number of instruments which can be connected to a party-line.

Each party-line terminates at a selector switch, to which all the subscribers' instruments are connected. When one of the subscribers wishes to use the line, he depresses a button and removes his telephone from the hook. This sets the selector switch automatically so as to connect his instrument to the line and leaves the other subscribers disconnected and the rising of the button shows him that he is through to the line. The subscriber then rings the exchange. Should any other subscriber try to get in while the first subscriber is still on the circuit, his button does not rise after it has been depressed, showing that the line is engaged. The automatic switch works in such a way, however, that his instrument is connected to the line as soon as the first subscriber clears by hanging up his telephone.

In connection with the instruments at each operator's position at the switchboard is a "selector disk" with a number of finger holes in it, corresponding to the number of subscribers on the party line. To ring up one of the subscribers, the operator, having plugged into the jack in the usual way, places her finger in the hole marked with the subscriber's number and pulls the disk round. This sends a number of impulses corresponding to this number to the automatic selector switch, already referred to, which connects the subscriber in question to the line.

We had an opportunity of inspecting an installation for a 10-subscriber party-line this week, and were able to see these successive operations carried out. To give a more detailed account of the system, we add a diagram (Fig. 1) applying to a magneto exchange. It may be mentioned, however, that the system has also been fitted on a central-battery exchange—in fact, one is under trial by the National Telephone Company at its Holborn exchange, the party-line serving some of the offices of the heads of the engineering departments at the company's chief office.

On subscriber 2 depressing the button N (the position of this button is seen at

---

* From the "Electrician," London.

N_1 on the instrument of subscriber 1) and removing his telephone from the hook, he places his own A line to earth through the releasing coil R. At first this coil is not energized as there is a high resistance in circuit, and the button is retained by a clutch. A circuit is formed through the spring at F corresponding to this subscriber's instrument to the bar upon which it rests and thence through the relay R_1 (which has a resistance of 1,000 ohms) to the actual A line and through a pendulum contact and battery at the exchange to earth.

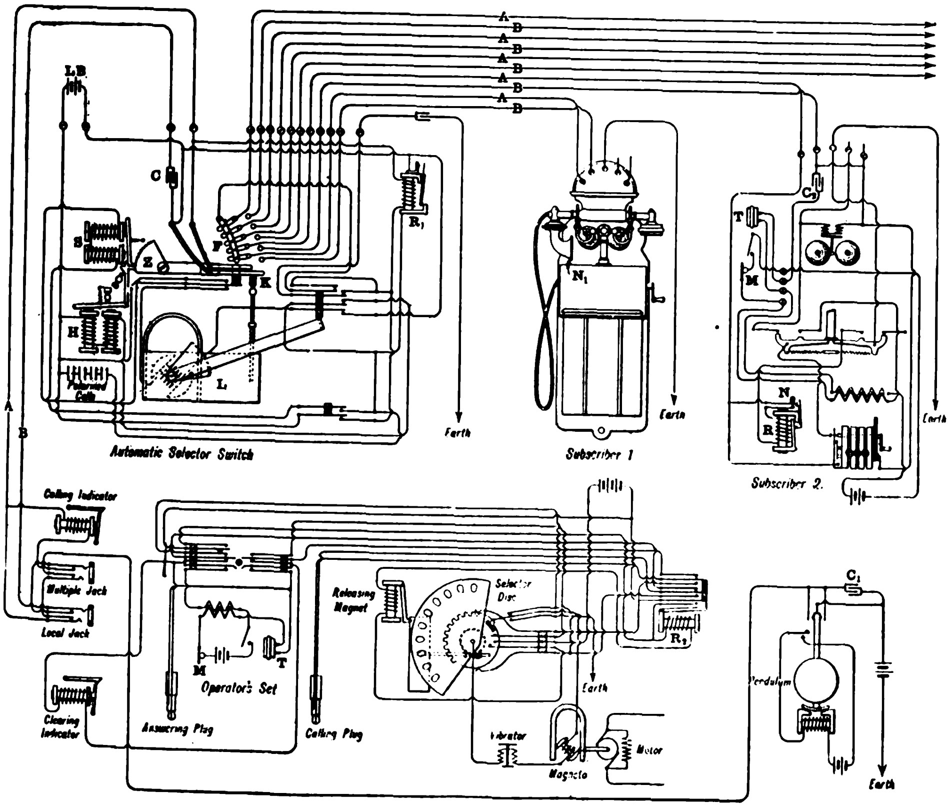


FIG. 1.—DIAGRAM OF CONNECTIONS.

The tongue of the relay oscillates backwards and forwards, and a current impulse is sent from the local battery LB through the step-by-step electromagnet H. This moves the ratchet Z, causing the arm K to travel over the spring contacts above it. As it moves along, it disconnects the subscriber's line springs one by one from the common bar, and as soon as it reaches the spring corresponding to the subscriber who is called, it breaks the coil-circuit of the relay R_1. As this relay is no longer operated the arm cannot travel any further and stops at this position, connecting both the A and B line to the corresponding lines leading to the subscriber's instrument. The B line is connected through a condenser C. As the A line is now connected direct to the subscriber's line instead of through the resistance of the relay R_1 sufficient current flows through the releasing coil R in the subscriber's instrument to release the button N, and the earth connection is at the same time removed from the loop. The subscriber now is connected to the exchange and his ringing current passes through the indicator which is bridged across the A and B lines. As soon as the operator plugs into the jack she cuts off not only the calling indicator but also the pendulum circuit.

It should have been mentioned that as soon as the lever K starts moving the arm of the second mechanism, L, is released and drops slowly, opening the contacts seen above it, one of which is included in the circuit of the relay R_1. At the end of its travel (which occupies 50 seconds) the lever L closes the two contacts below it. If now another subscriber plugs in, nothing further happens after he presses his button N, for the circuit of the relay R_1 is open on these upper contacts. When the subscriber has finished speaking he hangs up his receiver and the bell coil is placed across the line. This closes the circuit through the A line to the relay R_1, and thence through the bottom contact closed by the lever L through the local battery LB and back to the B line at the selector switch. The secondary contact of this relay now closes the circuit of the releasing electromagnet S, which allows the ratchet Z to fall back to its initial position; and when the arm drops the circuit of the coil L is also closed, so that the arm of this mechanism is raised to its normal position. When the arm has risen to its top position and is locked there, it opens the circuit of its own coil by means of the contact immediately above it. Everything is thus restored to its normal position.

A point worthy of notice is the introduction of "polarized cells" with aluminum electrodes to take the induction current on breaking the inductive circuits in connection with the local battery, and so diminishing the report heard in receiver.

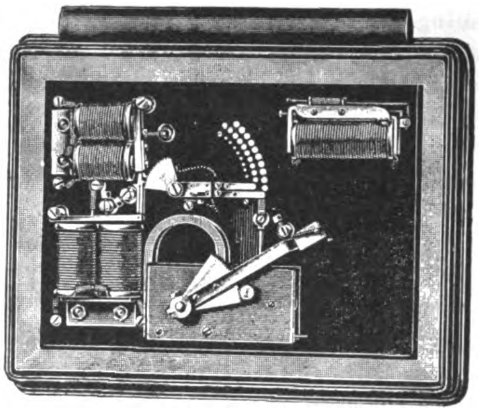


FIG. 2.—AUTOMATIC SELECTOR SWITCH.

We have now to consider the process of calling up one of the subscribers from the exchange. The jack of the subscriber being plugged with the calling plug in the usual way, the operator pulls over the disk selector, as already explained, and then momentarily presses to the left the ringing key seen above the operator's

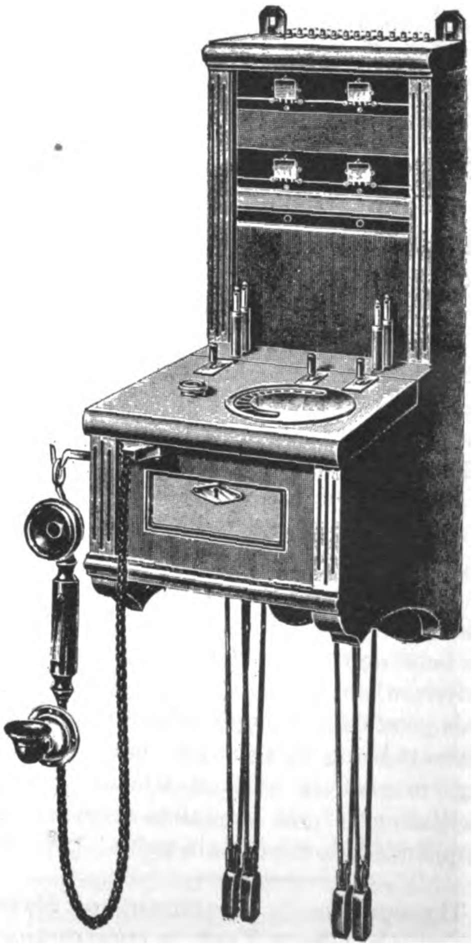


FIG. 3.—SMALL EXCHANGE FOR FOUR LINES.

set in Fig. 1. The disk selector stays in osition until the ringing key is pressed. The circuit of the retaining coil R_2 is then closed through the battery B and the releasing magnet, and as the disk flies back it closes a succession of contacts, sending impulses from the magneto over the A line through the coil R_1 controlling the automatic switch. The arm of the switch is therefore moved up to the position corresponding to the number of the subscriber wanted, and at the same time the arm of L starts traveling downwards. As soon as the selector switch makes contact with the subscriber's instrument, the disk selector, just before reaching its zero position, sends a ringing current from the magneto through the loop for a few seconds. A vibrator at the operator's position shows that the bell is ringing. If the subscriber does not answer, the operator can ring again with her ordinary ringing key. As it takes 50 seconds for the arm of the lever L to drop, after this period she no longer rings the subscriber unless she turns the selector disk again. The period of 50 seconds is selected to give the subscriber time to answer the call.

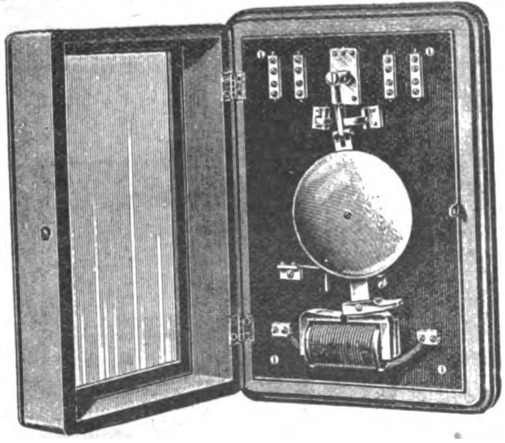


Fig. 4.—Electrically-Controlled Pendulum.

Fig. 2 shows the automatic selector switch, the relative positions of the various parts being the same as shown in Fig. 1. Fig. 3 is a small exchange for four lines and shows the relative size of a selector disk and Fig. 4 is the pendulum for sending the impulses to the selector switch when the subscriber is calling. This pendulum is electrically driven, the contacts being so arranged that the driving magnet is excited whenever the oscillations of the pendulum decrease in amplitude below a certain point.

* * *

The equipment department of Mare Island (Cal.) Navy Yard is constructing two sets of the Lodge-Muirhead system of wirelsss telegraphy which will be installed at Honolulu and Guam under the direction of the Navy Department.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

ELECTROPLATING.

The Deposition of Metals.—The general process of depositing metals by means of electricity has developed into an industry represented by several distinct branches. Each of them is of importance in the commercial world and covers the fields respectively of:—

1. Electroplating.
2. Electrotyping.
3. Electro-metallurgy.

Electroplating.—This process might be defined as one in which a thin layer of metal, such as copper, nickel, gold or silver, is deposited by means of electricity from appropriate solutions called plating baths. The thickness of metal deposited is known in the case of those that are termed precious, as gold and silver, and in consequence expressions are used such as triple or quadruple plate, etc.

Electrotyping.—The common expression, electrotype, is employed in all printing and publishing houses in connection with the duplicates of photo-engravings, used so extensively in this class of work.

An electrotype therefore is the exact duplicate, or as some term it, *fac-simile* of such cuts or engravings as would be endangered by use in printing. These facsimiles are obtained by a plating process finally, though certain important preliminary processes are necessary. The name was probably derived from the practice of taking a wax impression of type and plating this impression with copper; hence the term electrotype.

Electro-metallurgy.—The refining of copper and other metals cannot be better done than by means of the electric current. Instead of delicate preparations being made for a thin film of metal, as in the last two cases, the current is utilized for the purpose of separating the pure metal from all impurities and depositing it in thick plates at the cathode. The anode would therefore be the crude ore, probably in the shape of a block, dipping of course in the correct solution. Although this process is much more magnified than either of the last two, it is evident that it does not differ essentially from either, though the skill required in each case is of an entirely different character. The last is more associated with mining plants, particularly of copper ore, while both electrotyping and electroplating are fine arts.

Principles of Plating.—That which might be outlined as the principles of plating would embrace questions of correct current, electromotive force, solution and certain preparatory processes. In other words, the current must not be too strong and in addition the EMF. must be capable of carrying the metal over. Cleanliness is an important item in this process as the pressure of oil or grease in any form will prevent the cathode from receiving its proper coating. The principles of plating can therefore be best defined as follows:

1. Current of the proper strength per unit area of cathode.
2. Voltage suitable for the metal to be plated.
3. A solution electrolytically correc for the deposition of the metal at the anode to the cathode.
4. A perfectly free surface at the cathode with no traces of oil or grease.
5. A uniform current and EMF.

In all arts, human skill, which is the direct result of extensive experience, is rarely if ever limited in its exercise by set rules. In electroplating, skill of this character has developed to a high point and it may be considered as relating to two important features of the work as follows:

First—Skill in the mixing and preparation of solutions.

Second—Skill in the adjustment of the amperage and voltage employed.

It is necessary to consider the solutions from which various metals can be obtained by plating. These, as in the case where alloys are deposited, are only produced as the result of great knowledge of the art of plating. The dynamo has displaced the battery in the art of plating and electrotyping, though small equipments can be purchased which are only operated by a few cells. A shunt wound dynamo is generally employed whose voltage can be readily varied from 10 or 12 volts to 3 or 5 by means of the rheostat in circuit with the field winding. By this means the pressure can be adjusted to suit the metal to be plated over.

Plating Solutions.—The plating solutions in greatest use to-day are gold and silver among the precious metals, and copper, nickel and the alloy brass among the baser metals. The basis of these solutions are metallic salts manufactured with reference to the object in view and therefore called plating-salts.

Copper Plating Solution.—Too great a density in the copper solution must be avoided or the deposit will be brittle and crumbling and in addition very slow in making its appearance. A strong, tough deposit is obtained by a current of about 15 amperes per square foot of cathode surface. This solution may be made up either acid or alkaline. If acid, the deposit cannot be had upon iron or any other metal affected chemically by the acid. The following is an acid solution: "Prepare a saturated solution of copper sulphate by pouring hot water on the crystals of nearly the bulk required; add to this for each gallon of solution, a quart of water, and finally stir in for each gallon of solution four ounces of sulphuric acid. In the preparation of the solution it should be noted that by "saturated" is signified that state of the liquid when it will not dissolve any additional salt. The crystals may be dissolved in a separate vessel and then poured into the depository trough, or the trough may be nearly filled with warm water and the crystals dissolved into it from a few muslin bags suspended in the liquid. The water used must be either distilled or filtered or at least the solution filtered when complete. This solution is well adapted for most purposes of the electrotyper and has been tested repeatedly. It will deposit well upon metals or upon blackleaded moulds, and will be found to dissolve the anode freely when the current is passing. Some electrotypers use a large percentage of sulphuric acid, but this is seldom required except in very cold weather."—From Urquhart's Electrotyping.

An alkaline copper solution suitable for deposits upon iron, zinc or pewter, is here given: "Prepare a solution of copper sulphate, and also one of cyanide of potassium: add the latter to the former when a copious deposit of copper cyanide will take place. The liquid should be poured off and the residue washed, when it may be finally dissolved in a fresh solution of cyanide of potassium (two pounds to the gallon), to form the depositing liquid. As the cyanide of copper is not freely soluble in the potassium cyanide, it should be desolved to saturation. Free cyanide should be afterwards added to the extent of two ounces per gallon. This will promote rapid working, but there is also a stronger tendency to give off hydrogen at the cathode, the deposit at which may contain large quantities of gas. This solution works best at a temperature of 100 degs. Fah."—Urquhart's Electrotyping.

Nickel Solution.—The double nickel salts are generally purchased in commercial form ready for solution according to these directions: "Dissolve the compound in hot water to saturation; afterwards dilute with water. The proportions are three-quarters of a pound of salts to one gallon of water. The solution should be neutral or nearly so, that is neither acid nor alkaline. To ascertain this, test it with blue litmus paper; if the paper turns red increase the alkaline by adding ammonia sulphate. If red paper be turned blue, increase the acid by adding nickel sulphate until the mixture is as nearly as possible neutral. If there is a tendency to either side in working, it is better to have it utter alkaline."

Brass solution.—The making of a brass solution, the components of which are copper and zinc salts, given in the following formula: "Dissolve in 1,000 parts of water, 25 of copper sulphate, and 25 to 30 of sulphate of zinc; or 12½ of acetate of copper, and 12½ to 15 of fused chloride of zinc. Precipitate the mixture by means of 100 parts of carbonate of sodium dissolved in plenty of water and stir the mixture. Wash the precipitate several times by adding water to it, stirring and allowing the precipitate to subside, pouring the clear liquid away. Add to the washed precipitate a solution composed of 50 parts of bisulphide of sodium dissolved in 1,000 of water, and whilst stirring add a strong solution of ordinary cyanide of potassium until the precipitate is just all redesolved, then add three parts of free cyanide. This solution is used warm or hot. A current of about 12 volts must be employed and an anode of brass. When the deposit is white it can be attributed to too strong a current and if the deposit is red it is due to too weak a current. It is a simple matter to experiment with a small bath of solution, and a small anode and cathode, before attempting heavier work. A strong deposit of brass is a very handsome form of plating, which wears well and is not very difficult to obtain."

Slow Deposits.—The slow rate of deposit observed in plating is due to the employment of a weak current. This is frequently the case when an attempt is made to get a deposit upon a black leaded surface. In this case the resistance is naturally very great, and in consequence, very little current passes. The remedy for this is a higher pressure, the use of which in moderation, will hasten the process of deposition.

Unclean Anodes.—Absolute cleanliness is a guarantee of success in plating or electrotyping, and the reverse simply invites failure. Unclean anodes, on the surface of which dirt and oil or grease may be present, will greatly interfere with the work of plating. Some of this dirt, which is called by a philosopher, "matter in the wrong place," has been analyzed by a chemist and found to consist of particles of a great many different kinds of metals in the proportions in one particular instance of tin 33, copper 9, antimony 9, arsenic 7, silver 4, sulphur 2, and nickel 2. A certain amount of organic matter also is found present, which militates against successful plating. Thorough cleansing is the effective means of disposing of this, such as washing after a dip into an alkaline bath.

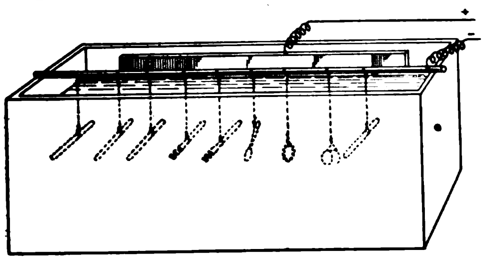
Electrotypes of Coins and Surface Pieces.—The surface is put through a preparatory process by first varnishing the back with beeswax of some rapid drying insulating solution. The face to be plated must be cleaned thoroughly and then rubbed over with turpentine in which a little beeswax has been dissolved to avoid absolute adhesion between the electrotype and original. The use of small trays is recommended, with a connecting wire attached. These depositing trays just hold a coin securely, and make perfect contact between it and the cathode.

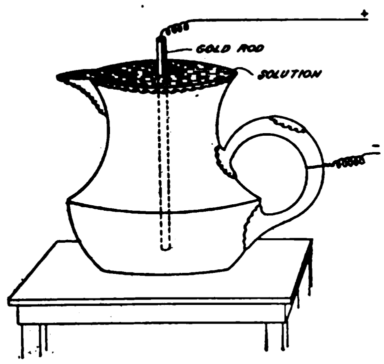
When a dry, clean surface is first placed in the solution the liquid may not take hold, due to a minute film of air on the surface. This must be removed by wetting the coin until signs entirely disappear.

Wax Impressions.—The intaglio or impression of a coin in wax is obtained by cleaning it thoroughly, and then dusting its surface very carefully with plumbago, leaving only a delicate film. It is then placed flat upon the wax plate of composition and pressure applied in the electrotyper's press. If a good impression has been obtained, the surface is dusted over with plumbago by means of a soft camel's hair brush.

Formula for a Conducting Solution for Moulds.—To obtain a conducting surface without the use of plumbago, the following formula is recommended: "Dissolve phosphorous in pure alcohol until a strong solution is obtained and wash the mould with the mixture. A silver solution is prepared by dissolving nitrate of silver in aqueous ammonia to saturation. It is to be poured evenly over the surface of the mould, and allowed to float over it for a few minutes; the solution is poured off and the mould allowed to become partly dry, when it is again floated with the mixture. Spots that do not appear to take the solution readily must be wetted with it by means of a soft brush." A surface prepared in this manner is actually covered with a film of precipitated silver, highly conductive, and by some considered far superior to the old-established plumbago process. From what has proceeded, it may be learned that the degree of saturation of the solution, and the strength of current, are always related to each other in a manner that can only be ascertained experimentally. Thus, if a saturated solution of copper is employed, the deposit is crystalline. If the solution is diluted with from two to four times its bulk of water, the metal is deposited in a malleable state, and a still further dilution will invite deposits of a granular character. A weak solution and a strong current will cause a black, spongy coating to appear associated with hydrogen bubbles. Under conditions which remain uniform, a definite deposit per second, per minute and per hour, is assured. An ordinary electrotype takes about five hours to become thick enough for service.

Pewter Vessels.—This class of vessels are first copper-plated before undergoing the gilding or silvering process. The process of gold plating requires the use of the salts called the double cyanide of gold and potassium, and silver plating the double cyanide of silver and potassium. In plating with either of these solutions, the above mentioned precautions are necessary as regards absolute cleanliness, etc. When silver is being plated too heavy a current, which forces the deposition, will give rise to a gray and crumbling coating. Bisulphide of carbon in a minute quantity, will make the deposited silver bright if introduced into the solution. In gold plating, generally performed in the insides of silver plated utensils, the gold solution is poured into the vessel, and a gold anode suspended in the center from the positive pole of the dynamo, the negative being attached to the article itself.




+
GOLD ROD
SOLUTION
-

The plating of small utensils in a bath and the gilding of the inner surface of a pitcher.

* * *

Plans are being prepared to equip the Delaware & Hudson Railroad, between Wilkes-Barre and Scranton, Pa., with a third-rail system for passenger car service.

CONVERSION OF A TELEPHONE EXCHANGE FROM THE MAGNETO TO THE CENTRAL BATTERY SYSTEM.*

BY B. S. COHEN.

(Concluded from page 237.)

While the exchange is under construction the outside engineering and the instrument-fitting departments will be at work.

The work to be done by the former will vary according to the existing conditions. If the subscribers' lines are already underground it will merely be necessary to divert the ducts and cables into the new premises, making the diversions in such a manner that the existing cables leading into the old exchange are teed or looped into the new cables and can be cut away from the latter when the change-over is effected.

If the system is an overhead one, and owing to wayleave difficulties it is quite impossible to put the wires underground, then the only alternative is to put as many of the open wires as possible into aerial dry-core cable.

For underground work, the modern tendency is to use cables with a large number of pairs, 306-pair cables and considerably over being quite commonly used. For conduits, glazed earthenware pipes laid in cement or cement blocks are probably the most satisfactory.

The distribution from the termination of the underground cables to the subscribers' offices is generally effected by means of open wires, and with a properly designed system the aim should be to keep the length of the open distributing wires to a minimum consistent with reasonable expenditure. With an underground system already existing, the new cables will be either looped or teed in, the method adopted depending on the distance between the old and new exchanges, and the position of the new exchange with respect to the heaviest cable routes.

Figs. 4 and 5 show arrangements of the cable generally adopted when the new exchange is quite close (within a couple of hundred yards of the existing one). In the first arrangement tee joints are made and in the second the cables are looped in. It will be seen from the drawing that the operations at the change-over are simple, it merely being necessary to disconnect the old exchange by inserting wooden plugs into the test jacks. The old leads can be cut away after the opening of the new exchange. When Fig. 5 is adopted, the old exchange can be immediately disconnected by cutting away the temporary cross-connections at the new exchange, and the old cables can be recovered without interfering with the live cables. With the teed-in system, however, the live teed joints have to be stubbed. On the other hand, the looped-in system is not so economical in cable. Further details of the change-over will be described later on. When the new exchange is some distance from the old one and is on the heaviest side of the routes, as it should be if its position is an improvement on that of the old exchange, a modification of the looping-in method must be employed.

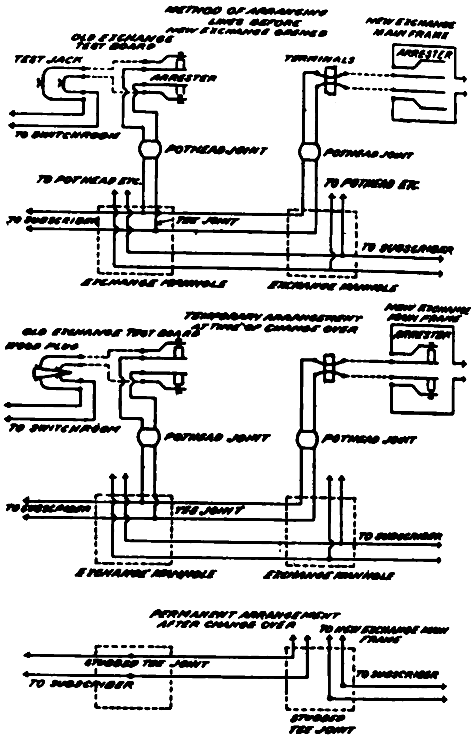

METHOD OF ARRANGING LINES BEFORE NEW EXCHANGE OPENED
NEW EXCHANGE MAIN FRAME
OLD EXCHANGE TEST BOARD
TEST JACK
TERMINALS
ARRESTER
ARRESTER
TO SWITCHROOM
POTHEAD JOINT
POTHEAD JOINT
TO POTHEAD ETC.
TO POTHEAD ETC.
TO SUBSCRIBER
TEE JOINT
TO SUBSCRIBER
EXCHANGE MANHOLE
EXCHANGE MANHOLE
TEMPORARY ARRANGEMENT AT TIME OF CHANGE OVER
NEW EXCHANGE MAIN FRAME
OLD EXCHANGE TEST BOARD
WOOD PLUG
ARRESTER
TO SWITCHROOM
POTHEAD JOINT
POTHEAD JOINT
TO SUBSCRIBER
TEE JOINT
TO SUBSCRIBER
EXCHANGE MANHOLE
EXCHANGE MANHOLE
PERMANENT ARRANGEMENT AFTER CHANGE OVER
TO NEW EXCHANGE MAIN FRAME
STUBBED TEE JOINT
TO SUBSCRIBER
TO SUBSCRIBER
STUBBED TEE JOINT

FIG. 4.

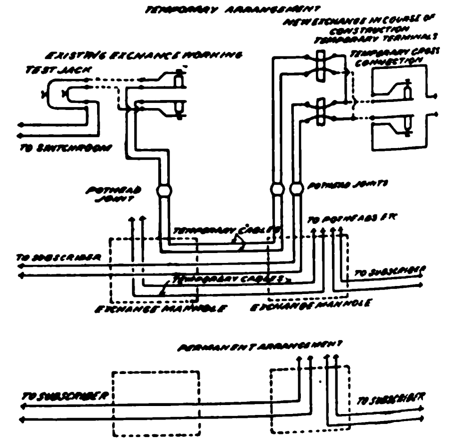

TEMPORARY ARRANGEMENT
NEW EXCHANGE IN COURSE OF CONSTRUCTION
TEMPORARY TERMINALS
EXISTING EXCHANGE WORKING
TEMPORARY CROSS CONNECTION
TEST JACK
TO SWITCHROOM
POTHEAD JOINT
POTHEAD JOINTS
TO POTHEADS ETC
TEMPORARY CABLES
TO SUBSCRIBER
TEMPORARY CABLES
TO SUBSCRIBER
EXCHANGE MANHOLE
EXCHANGE MANHOLE
PERMANENT ARRANGEMENT
TO SUBSCRIBER
TO SUBSCRIBER

FIG. 5.

Fig. 6 illustrates this method. The cables passing the new exchange are cut into and cables leading both in and out are brought on to the main frame. The subscribers to the right of the new exchange have thus had their lines shortened and the lengths of cable between the old and new premises will be used temporarily for maintaining the circuits through to the old exchange, and when the change-over is made are available for bringing in the circuits to the left of the new exchange. To illustrate this, two lines are shown on the drawing, viz.—Nos. 840 and 300—of which 840 is assumed to be a subscriber to the right of the new exchange and 300 is one to the left of the old exchange. The cable carrying the line in from 840 is terminated on a pair of horizontal terminals on the main frame in the new exchange and cross-connected to the pair of arresters in connection with No. 840 line inside the new exchange, and it is assumed that the line out from 840 to the old exchange will be ultimately used for bringing in No. 300 to the new exchange. This line out is terminated on another pair of terminals and cross-connected to 300 line inside the new exchange. In order to keep No. 840 working until the change-over takes place, temporary cross-connections marked A and B are run, connecting the line-in to the line-out. Now turning to the old exchange, the working test jacks and arrester in connection with lines 840 and 300 are shown and an additional test jack, C, which is a temporary arrangement, is also shown, wired to both 840 and 300. A wooden insulating plug is inserted in this test jack, and it will be seen that when the plug is withdrawn 300 and 840 will be connected together as far as the old exchange is concerned.

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*From the "Electrical Review," London.

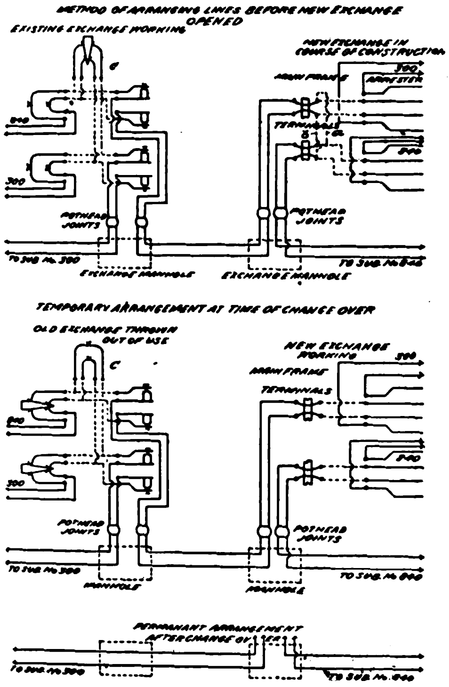
METHOD OF ARRANGING LINES BEFORE NEW EXCHANGE OPENED
EXISTING EXCHANGE WORKING
NEW EXCHANGE IN COURSE OF CONSTRUCTION
MAIN FRAME
ARRESTER
300
840
TERMINALS
B
A
POTHEAD JOINTS
TO SUB. No. 300
TO SUB. No. 840
EXCHANGE MANHOLE
TEMPORARY ARRANGEMENT AT TIME OF CHANGE OVER
OLD EXCHANGE THROWN OUT OF USE
C
NEW EXCHANGE WORKING
MANHOLE
PERMANENT ARRANGEMENT AFTER CHANGE OVER

FIG. 6.

When the change-over takes place, the insulating plug is withdrawn at the old exchange and the temporary wires A and B, which are of a different color to the permanent wires in order that they may readily be identified, are cut away in the new exchange; 300 and 840 will then be working through to the new exchange.

The permanent connections are also shown in Fig. 6. It will be realized that great care must be taken in planning this method out. The leading-in cables from the pothead joints to the horizontal side of the main frame are generally made up of 22 S.W.G. wire, insulated with a combination of silk and cotton, and protected by a lead covering. They are made with a similar number of pairs to the cables to which they are joined, and are very compact; thus the 306-pair size is only 2 inches overall diameter.

We must now consider the work to be carried out by the instrument fitting department. As a temporary measure, in order to enable the existing instruments to work with both the old and new systems, a condenser of 2 mfd. capacity is inserted in series with the subscriber's bell, so that when the telephone is in the normal position the bell and condenser are across the loop. In most cases the condensers can be fitted in the battery boxes. No other modification is necessary in the circuits of the instruments, but as the receiver and secondary of the induction coil will close the loop during conversation, the former must be so arranged that the current from the central battery will produce a magnetic field in the same direction as that of the permanent magnet. If the receiver is connected up in such a manner that the field set up by the current from the central battery opposes that of the permanent magnet, the hearing will be faint. When the instrument fitter is inserting the condensers, he tests for this with the testing clerk at the exchange, who puts current in the proper direction on the line,

Condensers are also inserted in series with all bells or indicators in connection with switching apparatus of any description fitted at the subscribers' offices. The instruments are now capable of working on both the old and new systems, and after the change-over has taken place they can be replaced by new central battery instruments. The methods of working a number of extension and exchange lines on the central battery system at a subscriber's office are many and varied, in order to give the facilities for secrecy and intercommunication which are demanded in this country. Special bells are run from the central exchange to the subscribers' branch switchboards, to supply the power necessary for both speaking and signaling between the extensions, private lines, etc.

Whilst the conversion of the system is in progress, the lines are repeatedly tested from the new exchange as they are connected up to the main frame. With the voltmeter method of testing adopted, this work is carried out with ease and rapidity, and the test clerk can in a few seconds determine the insulation and copper resistance of any line.

A maximum copper and minimum insulation resistance is fixed for both subscribers' and junction lines, and the exchange relays are adjusted in order to operate through the maximum copper resistance with a sufficient factor of safety and to release with a resistance well below the minimum insulation resistance. When adjusting the relays, the maximum working current is also passed through them in order to allow for the effects of residual magnetism. The traffic department has to furnish lists showing how the subscribers' and junction lines are to be distributed on the switchboard. This is obtained from the records of calls per individual subscriber and calls per operator's position in the old exchange. A curve should be plotted showing the calls per operator's position per busiest hour, and an average line drawn with maximum and minimum lines at 10 per cent. above and below this respectively.

The exchange instrument modifications and outside system having been completed, the change-over can take place immediately after a complete test of the whole system has been carried out.

Owing to the large number and complex nature of the circuits, and the amount of apparatus, considerable time must be allowed for the final testing in a large exchange.

First comes the testing of the multiple jacks. In the new London Wall Exchange of the National Company, which has just been opened, there are a total of 681,550 jacks connected with the subscribers and outgoing junctions; each of these jacks is provided with three connections, the two lines and the engaged test, and each jack must be tested for disconnection, reversal of the three wires on the one jack or transposition with the wires on another jack, and for contact. Test boxes are generally provided for this purpose fitted with plugs and cords which can be inserted in the corresponding jacks at any part of the multiple, and relays and lamps so arranged that reversals, contacts, etc., will be indicated by lamps glowing. In order to obviate the liability to personal error in this test, and to increase the speed of test, an automatic arrangement provided with a form of Morse inker has been used.

The testing of the various circuits and

the relays in conjunction with them is carried out by means of test sets equipped with relays, lamps and resistance coils arranged to allow the maximum and minimum currents to flow through the circuits under test.

The tests of the charging and ringing machines, besides including the usual tests for efficiency, temperature-rise, etc., include a test for disturbances set up by the commutation, the charging machines having to take a varying exchange load direct without the cells in circuit and without the introduction of any serious disturbances on the lines.

The internal resistance of the battery is also taken and a test for cross talk made. Besides these tests, a proportion of the deliveries of all apparatus, such as plugs and jacks, relays, heat coils, fuses, lamps and keys are tested, both mechanically and electrically, in the test rooms at the headquarters of the telephone company to whom the exchange belongs and the remainder of the apparatus examined and passed by the clerk of the works, who is stationed at the exchange which is under construction, before it is allowed to be fitted up.

When all the faults discovered during the testing are rectified, a certificate of completion can be signed by the engineers responsible for the various branches of the work.

The change-over can now take place. This is usually carried out at the week end. To consider an actual case, it is assumed that the looping-in system has been adopted (see Fig. 6), and that the time for changing over, say 4 o'clock Saturday afternoon, has arrived.

Men are stationed at the old exchange test board by the temporary jacks c in order to pull out the wooden pegs, and others at the ordinary test jacks with a supply of wooden pegs to insert in them and thus disconnect the old exchange.

At the new exchange arrangement has been made to cut off the temporary cross-connections, and the heat coils have already been inserted in the arresters (these completing the connection between the inside and outside lines). Previous to this, however, the covers have been removed from the working line and cut-off relays and slips of thin insulating material inserted between the contacts of the cut-off relays. By this means the line apparatus is kept disconnected from the lines until the first insertion of the plugs into the jacks, when the actuation of the cut-off relays releases the insulating slips, which fall to the floor.

All the operators are in attendance, the majority at their positions in the new exchange, only sufficient being left at the old exchange to take the normal Saturday afternoon load, which is generally small. The operators in attendance at the new exchange will not find their surrounding entirely novel, as they have spent some time, in detachments of two or three, at the new board, familiarizing themselves with the multiple and the location of the various junction lines, order wire keys, etc., under the guidance of a senior operator or instructress from an operating school, if such exists. The actual change-over takes a surprisingly short time, even in a large exchange.

It is customary to provide the operators attending at the new exchange with lists of numbers which can generally be obtained during the slack time, such as hospitals, fire and police stations, and other public institutions, also doctors. These lines can be tried directly the change-over takes place, and the remaining lines on the first normal day.

Neutralizing Static Electricity.

At a meeting of the New England Cotton Manufacturers' Association, held in Boston April 26, a paper upon the above subject was presented by Philip Dana, of Westbrook, Maine. The writer stated that most mill men familiar with the manufacture of cotton, have been troubled by static charges on cold, dry mornings, either with a card or drawing frame, and that it has been greatly desired to overcome it completely. It has been found necessary to keep a fairly high degree of temperature and humidity in the rooms, partly to obtain more uniform and stronger work, and partly to overcome this static electricity. The use of moist steam is unhealthy, and a separate power plant for running humidifiers before the machinery is started up is not feasible.

The warps become thoroughly charged in passing through the rolls and cling to the trumpets, becoming greatly snarled and cutting down production on winders and beamers. Mr. Dana said that he had applied the Chapman process of removing static electricity to his unwinding machines with entire success, and that he anticipated using it next winter on drawing frames, especially where long stapled cottons are used, both carded and combed.

The device consists of a source of alternating current, such as any 110 or 220 volt a. c. lighting system, a transformer to raise the alternating current voltage from this potential to 10,000 to 20,000 volts, and an inductor to distribute this high voltage influence over the substance to be treated. The inductor consists of fine steel wires incased in hard rubber, the steel points being flush with the rubber case. The apparatus operates on the principle that a static charge spontaneously selects from a neighboring alternating charge the kind and quantity of charge sufficient to neutralize itself. As static electricity in any material is usually very small in quantity, although of very high voltage, the transformer may be constructed so as to limit the maximum output to a few milliamperes, thus making it perfectly safe for the operatives even if a person should take the whole charge. The process has also been successfully used in paper machines, printing presses, paper bag machines and woolen mills.

The International Railway Congress.

When the International Railway Congress opens in the city of Washington to-morrow the United States will, for the first time, entertain the eminent railroad men of the world in one of their quinquennial gatherings. Five years ago they met at Paris; ten years ago at London; fifteen years ago at St. Petersburg. There will be offered in conjunction with the formal meetings of the congress an ocular demonstration of all that is wonderful in American railroad science. For this undertaking, the manufacturers of railroad goods have clubbed together and made a small world's fair near the Washington monument. Congress granted them permission to use public ground for the purpose of the exhibition.

Mr. J. Alexander Brown, who is running this adjunct to the congress, says that neither the world's fair at Paris, the Chicago fair of 1893 nor the St. Louis Exposition last year had such displays of modern railroad machinery as this week's show will contain. There will be no "Dewitt Clinton" locomotives or other antiques, but the latest wrinkles in railroading will be plentiful. The manufacturers say the exposition will represent an outlay of over a million dollars, while the space occupied by exhibits will be greater than that devoted to similar displays at any of the world's fairs.

The General Railway Signal Company, which makes block signals and other devices, is spending $20,000 in setting up a life-sized locking station.

One of the interesting exhibits will be a battery of 60 sets of airbrakes, ranged side by side, so that the way they would work from end to end of a long train may be seen at a glance.

Electric locomotives for use in tunnels and mines are also among the exhibits.

Owing to the temporary character of the exhibit, and the fact that the parking cannot be cut up with ballasted tracks, no locomotives will be seen on the exposition grounds, but in the Pennsylvania yards, a half mile distant, 1,800 feet of trackage has been set aside for locomotives and cars. There, the principal locomotive companies and car building concerns of the country will show their wares under practical conditions.

The American Electrochemical Society's Boston Meeting.

The seventh general meeting of the American Electrochemical Society was held last week in Boston. Nearly 100 members were present.

A large number of papers were presented and those principally discussed were on the subjects of "Reversible and Irreversible Electrolytic Polarization," "The Aluminum Electrolytic Condenser," "Economic Temperature for Copper Refining," "Electrolytic Conduction," "Absoute Potentials," etc.

The newly-invented cell for the production of caustic soda and chlorine was described by the inventor, Mr. C. P. Townsend.

There were several exhibits of electrochemical apparatus and electric furnaces.

Consolidated Electric Smelting Company Organized.

The organization of the Consolidated Electric Smelting Company of Sault Ste. Marie is announced from Calumet, Mich. This new company will take over the interests of the Hatch Electric Smelting & Refining Company, combining the interests of both the old American and the old Canadian organizations. The new company has elected the following officers: George P. McCallum, president; F. C. Bowman, of Duluth, vice-president; A. E. Marriott, secretary; Cyrus W. Baldwin, treasurer.

The initial operations of the company will be directed toward handling zinc ores.

Iowa Electrical Association's Officers.

At the recent convention of the Iowa Electrical Association held in Dubuque the following officers were elected for the ensuing year: President, Austin Burt, Waterloo; vice-president, A. W. Zahm, Mason City; secretary, P. E. Bellamy, Knoxville, and treasurer, N. A. Maul, Belle Plaine.

Dixon Crucible Meeting.

At the annual meeting of the stockholders of the Joseph Dixon Crucible Company the old board consisting of Edward F. C. Young, John A. Walker, Edward L. Young, William Murray, George T. Smith, Joseph D. Bedle and George E. Long, was unanimously re-elected. The board of directors re-elected the former officers, namely, Edward F. C. Young, president; John A. Walker, vice-president and treasurer; George E. Long, secretary. Judge Joseph D. Bedle was also re-elected as counsel.

The stockholders present expressed themselves as thoroughly satisfied with the management of the company by its officers.

Of the total number, 7,345 shares, there were represented 7,145 shares.

PERSONAL MENTION.

MR. JOHN I. BEGGS of the North American Company has been elected president of the United Railways Company of St. Louis, succeeding Mr. Murray Carleton.

MR. J. M. BRAMLETTE, general superintendent of the East St. Louis (Ill.) & Suburban Electric Railways, has accepted the position of general manager of the Philadelphia & Western Interurban Electric Railway.

Inquiry for a Motor Generator.

Electricity Newspaper Company :

I am in need of a motor generator of about 13 to 15 kw. to be used at the coming dental convention of the New Jersey State Dental Society at Asbury Park this summer. I desire to run from the street electric car current wires 500 volts and reduce the same so that 110 volts direct current can be used in the building for running motors, dental furnaces, etc. If you have knowledge of any such generator will you kindly communicate with me and oblige Yours very truly,

Harvey Iredell.

New Brunswick, N. J., April 26, 1905.

Revolving Field Alternators and Rotary Converters.

The revolving field alternator for medium and large size machines, is now the standard type, and has been adopted by practically all American and European manufacturers. Bulletin No. 56, just issued by the Electric Machinery Company, Minneapolis, Minn., illustrates and describes in detail the revolving field generators and rotary converters, manufactured by this well-known concern.

In the revolving field machines, the base, bearings and armature are of massive construction to insure stiffness. The frame is of sufficient length to permit the armature being moved parallel to the shaft to give access to the fields and armature.

The bearings are strongly constructed, each one having two oil rings, and carefully cut oil grooves to insure perfect lubrication and cool running under heavy overloads.

The pole pieces have laminated tips and are provided with air ducts communicating with the inside of the field ring. The field air ducts index with the armature ducts so that good ventilation is easily obtained with little waste of power.

The rotary converters are built on lines similar to the direct current apparatus turned out by the above concern. Solid pole-pieces, extra heavy shafts and a rigid commutator are characteristics of these machines.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED APRIL 25, 1905.

Electric Railways and Appliances.

788,280. Electric Railway. Leon W. Pullen, Philadelphia, Pa., assignor to the Wireless Railway Company. Filed July 18, 1904.

788,290 Protected Third-Rail System. Isaac C. Thorne, Glen Cove, N. Y. Filed Jan. 2, 1904.

Electric Lights and Appliances.

788,493. Incandescent Electric Lamp. Herschel C. Parker, New York City. Filed July 2, 1904.

Electrical Machinery and Apparatus

787,904. Mechanism for the Transmission of Power or Motion. John Dring, London, Eng. Filed June 16, 1902.

788,151. X-Ray Meter. Tomas P. Hall, Chicago, Ill., assignor of one-half to Samuel T. Hutton, same place. Filed Feb. 15, 1904.

788,253. Electric Sparking Device for Explosive-Engines. Charles S. Dutton, Perth Amboy, N. J. Filed Jan. 26, 1904.

788,279. Alternating-Current Rectifier. Edwin H. Porter and Burleigh Currier, Philadelphia, Pa. Filed Oct. 7, 1904.

788,291. Dynamo or Motor. John A. Titzel, Sr., Franklin, Pa. Filed Nov. 9, 1901.

788,329. Pressure-Controlled Electric Switch and Air-Gauge. William J. Pugh, Davenport, Ia., assignor to the Automatic Electric Pump Company, same place. Filed Aug. 20, 1904.

788,365. Dynamo-Electric Machinery. John H. St. Hill Mawdsley, Taunton, Eng. Filed Sept. 17, 1902.

788,411. Electric Switch. Wesley D. R. MacDiarmid, Ottawa, Canada, assignor of four-tenths to Edward B. Bates, same place. Filed Jan. 23, 1904.

788,473. Armature. Charles W. Johnson, Norwood, and William Cooper, Cincinnati, O., assignors, by mesne assignments, to the Bullock Electric Company. Filed July 16, 1903.

Telephones and Telephone Apparatus.

787,930. Telephone-Switchboard. Charles T. Mason, Sumter, S. C., assignor to the Sumter Telephone Manufacturing Company. Filed Feb. 4, 1905.

787,969. Registering Apparatus for Telephone-Exchanges. David A. Yoder, Toledo, O. Filed Aug. 25, 1904.

788,452. Telephone-Transmitter Henry P. Clausen, Chicago, Ill., assignor to the American Electric Telephone Company. Filed Aug. 20, 1902. Renewed Feb. 8, 1905.

Miscellaneous.

787,905. Telegraphic Relay. Eugene Ducretet, Paris, France. Filed April 10, 1901.

787,936. Selective Signaling Device. Charles H. North, Cleveland, O., assignor to the North Electric Company, same place. Filed June 19, 1903.

787,957. Electrically-Heated Curling-Iron. Jules Szollosy, Brighton, Eng., assignor of one-half to Louis Hyman same place. Filed Jan. 11, 1905.

787,990. Electrical Interrupter. Thomas J. Murphy, New York City. Filed Sept. 14, 1903.

788,109. Electrical Panel-Board. Hubert Krantz, New York City. Filed Dec. 6, 1904.

788,166. Electrical System of Heating. Arthur D. Newton, Hartford, Conn. Filed July 9, 1904.

788,315. Method of Electrolytic Separation. William Hoopes, Pittsburg, Pa. Filed Nov. 30, 1904.

788,450. Electric Reciprocating Tool. Paul Centner, Verviers, Belgium. Filed Jan. 24, 1905.

788,477. Aerial Telegraphy. James F. King, New York City. Filed June 23, 1903.

THE TELEPHONE WORLD.

Reduction in Rates.

The New England Telephone Company has made some substantial reductions in its rates for certain classes of service in the Boston, Mass., Metropolitan and suburban exchanges. The new rates took effect May 1. These reductions have been made according to the policy recently inaugurated of reducing the rates so far as the operating expenses would permit.

For the suburban measured service, exchange rates allowing communication only between subscribers to the suburban exchanges on special circuit have been cut from 4 to 3 cents for additional calls, the rate for 600 calls, $48, remaining the same. On the two-party circuit the rate also remains the same, with a cut from 4 to 3 cents for additional calls.

On the unlimited suburban exchange, rates for residence stations for the special line have been cut from $66 to $54. On the two-party circuit from $51 to $42, while for four parties on one circuit there will be a new rate of $30. It is thought that these reductions will benefit a large number of the company's patrons and will enhance the value of the exchanges.

A number of citizens of Glasgow, Ky., met recently for the purpose of talking over the advisability of organizing a telephone system at that place. Something like $4,000 has already been subscribed to the fund, and the promoters claim that they will have no trouble in interesting enough money to put the enterprise through. The system in Glasgow is owned by the Gainesboro Telephone Company of Sparta, Tenn. The one to be established will be operated by the Home people.

News from Middletown, N. Y., states that the annual election of the Warwick Valley Telephone Company was held recently. W. A. Hynard, W. E. Bailey and F. M. Cummins were unanimously re-elected directors. The report of the treasurer showed the finances to be in excellent condition. It was voted that no dividend should be paid until the debts of the company are discharged.

The property, franchise and all appurtenances of the United States Telegraph & Telephone Company, with exchanges in 14 counties in Iowa, were sold last month to Thomas Cascaden, of Waterloo, for $55,000 at a public sale on order of the Federal Court.

The Grand Blanc, Mich., Telephone Company, an Independent organization, has been incorporated by Grand Blanc farmers and the following officers were elected: A. D. Banker, president; Dr. Parker, secretary; Cranston Clark, treasurer. About 50 farm residences will be connected on the start.

The Union Telephone Company of Trump, Md., of which Mr Charles L. Almony is president, and Mr. S. S. Van Trump manager, has increased its capital from $3,000. to $10,000, and will extend its lines.

The Van Dermark Telephone Company has been organized at Scio, N. Y., with a capital of $1,200. The company will build a line from Van Dermark Creek to Scio, there to connect with the Inter-Ocean Telephone Company's line.

Independent Telephone Movement in New York State.

A mortgage has been filed in the county clerk's office at Rochester by the Independent Union Company for $500,000, given to the Knickerbocker Trust Company to secure bonds for the same amount. The purpose of the company is to acquire and operate telephone lines and exchanges in Erie, Niagara, Chautauqua and Orleans Counties. The promoters of the Independent Union Company, in the Rochester Telephone Company and in the Independent Telephone Securities Company, whose home is in Utica, are in many cases the same and the expansion of the Independents gives promise that the Rochester company will ultimately be taken over.

The Independent Telephone Securities Company at present controls about 1,000 miles of telephone wires and 250 stations in Oneida, Lewis, Herkimer, Jefferson, Oswego and Otsego Counties. This is the result of the plan to establish a system by acquiring central of companies wherever it can do so on satisfactory terms, and this plan has led up to the important action now being considered.

The latter company recently executed a mortgage to the Security Trust Company of Rochester for $15,000,000 to secure a bond issue of equal amount, the proceeds of which will be used in acquiring companies. As fast as the Independent companies signify a desire to join the new company and participate in the long-distance service, they will be taken in and the bond issue authorized will be used to complete the financial arrangements. The whole amount of $15,000,000 in bonds will not be issued at once, but in amounts required to take in the companies as they are ready.

The Standard Manufacturing Company, makers of speaking-tubes and private-line telephones, will shortly move from Meriden to Bridgeport, Conn. Considerable Bridgeport capital has now been invested in the enterprise.

The proposed increase in the telephone rates has been discussed quite freely in Ilion, N. Y., and several of the business men and others have already taken steps to form a local stock company and operate an exchange in the village. The trustees will be asked to grant a franchise.

A new exchange of the Auburn Telephone Company, was opened lately in Watertown, N. Y., and over 2,000 residents called and inspected the building. There are at present over 1,400 connections from the Auburn office.

Articles of incorporation for the Orange Home Telephone & Telegraph Company, and for a similar organization at Anaheim, Cal., have been filed with the county clerk. The companies are branches of the Home telephone system and will be centers for connection with the existing lines in Orange County.

Plans have been filed for the enlargement of the three-story telephone exchange of the New York Telephone Company, at No. 424 West 58th street. The cost of the improvement is estimated at $125,000.

The Warrington, Pa., Mutual Telephone Company has made arangements to extend its line from Warrington to North Wales via Chalfont. This will give it an outlet through the Keystone Company, where connection can be made for long distance calls. A large percentage of the farmers about Warrington, Tradesville and Chalfont have telephones in their houses. A number of prominent people in North Wales are interested in the movement. This will be a great convenience to the farmers, as the expense of building and maintaining this line is nominal.

A director of the Pittsburg & Allegheny, Pa., Telephone Company is quoted as saying that during the months of March and April of this year, the company put in more private exchanges than during any similar period in the company's history. The business is said to be growing nicely. Although the company's common and preferred stock have been listed on the local exchange for more than two months, no sales of either issue have ever been posted. The common quotes at 15 bid, and the prferred at 60 bid.

The annual meeting of the Bloomer, Wis., Telephone Company was held last month. The officers elected for the year were: President, Henry Lebeis; vice-president, P. A. Peterson; secretary, E. R. Parker; treasurer, W. E. Kitch. The directors will declare a 12 per cent. dividend.

The Colorado–Wyoming Telephone Company lately filed its articles of incorporation in the office of the Secretary of State at Denver. The company is a Wyoming corporation, and conducts a telephone system in northern Colorado and southern Wyoming. The filing was made in connection with the appointment of T. C. Williams, of Greeley, as the agent.

Joseph Studebaker has secured a franchise for a telephone system in Flora, Ind., and will receive bids for the installation of an exchange, poles, wires, etc.

The Central Union Telephone Company contemplates placing its wires underground in Youngstown, O.

The Sunset Telephone & Telegraph Company proposes a subway system for its wires in Tacoma, Wash.

A telephone franchise has been granted to Ed. J. Vaughn and others by the Jerseyville, Ill., city council.

The Byron, N. Y., Telephone Company's business has grown so far beyond all expectations that a new switchboard has had to be installed.

Telephone Incorporations.

The Southern Cayuga Telephone Company, Poplar Ridge, N. Y. Capital stock, $15,000. Incorporators: Isaac P. Hazard, Charles Pyle and Isaac P. Hazard, Jr.

The Badger Telephone Company, Oconomowoc, Wis. Capital stock, $2,000. Incorporators: Thomas Steele, John J.. Reid and Henry E. Rosnon.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Albion, Mich.—The council has granted a 30-year franchise to the Albion Electric Light Company.

Ashland, Va.—It is reported that the Virginia Passenger & Power Company has received the contract for lighting this town with electricity.

Bryan, Tex.—The building and operating of an electric light plant here is considered favorably by the committee of aldermen, who were appointed to look into the matter.

Canton, N. Y.—The amount of $10,000 is to be expended in improvements by the electric light company of this place.

Clarinda, Ia.—Plans are being prepared for the erection of the new building of the Lee electric light plant.

Conrad, Ia.—This city is to have an electric light plant soon.

Dubuque, Ia—The city council is discussing the question of putting in incandescent electric lights in the alleys of the business part of this city.

East St. Louis, Ill.—The city council has granted to the St. Clair Light & Power Company, of this city, a franchise to erect an electric light plant to cost $50,000.

Ione, Ore.—It has been decided to issue bonds to cover the cost of a municipal electric lighting plant, which will be installad immediately.

Kennewick, Wash.—E. Wood, of Genesee, offers to put in an electric light system and a flour mill here at once, if he can secure a franchise for the electric light system.

Maytown, Pa.—This village has contracted to have its streets illuminated by electric lights.

Monroe, Ga.—The citizens recently voted to issue bonds for an electric light plant.

Monticello, Fla.—The Monticello Power Company has been incorporated with a capital of $10,000 to operate an electric light and power plant.

Oxford, N. S.—The electric light plant and many business places were totally destroyed by a recent fire.

Pawnee, Ill.—Arthur Carswell has purchased the electric light plant from Alvin Underwood.

Sterling, Col.—The Sterling electric light plant, owned by O. P. Sells, of Grand Island, Neb., was totally destroyed by fire. The loss is estimated at $18,000.

St. Augustine, Fla.—At a recent meeting of the city council a communication was received and read from Gen. J. C. R. Foster, submitting a proposition to install an electric lighting, heat and power plant in this city.

STREET RAILWAYS.

Ann Arbor, Mich.—A franchise has been granted to the Adrian & Ann Arbor Electric Railroad Company by the city council. This is the last franchise necessary, and the construction of the line will be begun at once.

Atchison, Kan.—Brown and Doniphan County people are talking of the proposed electric line to run out of this city, with the purpose of reaching the best towns in both counties.

Bloomington, Ill.—The Bloomington, Decatur & Champaign Interurban Company has bought the Consumers' Electric Light & Heating plant of this city for $130,000. The plant will be used to supply power for the chain of interurban lines throughout central Illinois.

Carrollton, Ky.—The Shelbyville & Ohio River Electric Railway Company, which has been incorporated at Eminence, is going to build an electric railway from Shelbyville to this city, a distance of 42 miles. Luther H. Leber, of New York, civil engineer, has been surveying the route through Carroll County.

Clarksville, Tenn.—The Clarksville Street Railway Company has purchased the plant of the Queen City Electric Light & Power Company; extensive improvements will be made.

Cleveland, O.—The Cincinnati, Dayton & Toledo Traction Company has increased its capital from $5,000,000 to $5,250,000.

Des Moines, Ia.—The Rock Island road is seriously considering the use of electricity on portions of its lines out of this city, and officers of the company have gone over the lines, where it is proposed to do this work, with electrical engineers. These engineers have been supplied with plans of the road, profiles, etc., and are now engaged in drafting plans and preparing estimates for the work.

Elmira, N. Y.—An electric line is soon to be erected between this city and Waverly.

Evansville, Ind.—The Evansville & Mount Vernon Electric Railway Company, capitalized at $10,000, has filed articles of incorporation to build an electric line between here and Mount Vernon. Fred P. Leonard, William N. Ford and others are interested.

Guadalajara, Mex.—M. C. Miller, of this city, is making good progress in his project for building an electric railway from this city to the port of Chamila, on the Pacific coast of Mexico.

Indianapolis, Ind.—The Indianapolis & Chicago Air Line Traction Company has been incorporated under the laws of the State of Indiana and will build and operate an electric line between this city and Chicago.

Kalamazoo, Mich.—Eastern capital proposes building a trolley line from here to Niles, 70 miles long, the missing link that will connect Chicago and Cleveland, and which will be, when completed, the greatest electric line in the world. The entire line will be 500 miles long.

Kenton, O.—The Sandusky & Southwestern Traction Company of Ohio has been reorganized, and is getting ready to complete the line from Wapakoneta to this place. For further information address F. H. Blodgett, Wheeling, W. Va., contractor for said company.

La Crosse, Wis.—The La Crosse Street railway Company will extend its electric line from Onalaska to Holmen, a distance of about 10 miles.

Middletown, N, Y.—The Wallkill Transit Company has recently been organized here and incorporated with an authorized capital of $350,000, as a successor of the Midletown-Goshen Electric Railway Company.

Monroe, Mich.—The talk of an electric line from this city to Dundee, 17 miles, is assuming definite shape. The village of Maybee will be on the line, and it will also tap the vast glass sand deposits west of this city.

Oconomowoc, Wis.—The Milwaukee Light, Heat & Traction Company has been granted a franchise to build an electric railway from Waukesha Beach to this city.

Platteville, Wis.—A party of men from Fargo, N. D., are behind a plan to build a trolley line from Galena to this place. The object is to reach several mines which are being developed.

Sandusky, O.—D. D. Washburn, of Greenwich, has filed an application with the county commissioners for a franchise for an electric line through the village of Greenwich and on other public highways in the county.

Shelbyville, Tenn.—It has been announced that all the money necessary to build and equip the proposed electric railway from here to Fayetteville, and thence to connect with the Southern road at Huntsville, has been raised, and that the line will certainly be built.

Stratford, Ont.—A company has been incorporated to build an electric railway from here to Great Bend and Lake Huron.

Walnut Creek, Cal.—An electric road will be built to connect this city with Oakland, Danville and Concord.

Washington, D. C.—Acting on the advice of Attorney General Moody, Secretary Taft has granted permission to a street railway company to construct an electric line over the Government bridge across the Mississippi at Rock Island.

POWER PLANTS.

Chicago, Ill.—The Chicago Southern Traction Company has purchased a site in Riverside, for the construction of a new power plant, to cost $100,000.

Dover, Del.—The Citizens' Light, Heat & Power Company, with a capital of $300,000, has been incorporated to erect plants for generating electricity.

Holyoke, Mass.—A water power plant, to cost $150,000, is to be erected here according to plans made public by Treasurer R. C. Winchester, of the Holyoke Water Power Company. Charles E. Gross, of Hartford, Conn., is president of the company, and much of the stock is held in that city.

Providence, R. I.—Plans are being prepared by Architect Richard P. Jenks, Banigan Building, this city, for the erection of a new power plant for lighting purposes.

BIDS WANTED.

Bristol, Va.—Cash bids for a franchise to operate electric light and power plants here, will be received by President J. W. Mort until noon May 10.

Fort Sheridan, Ill.—Sealed proposals in triplicate will be received until May 10 at the office of the constructing quartermaster here, for furnishing and installing electric light fixtures and wattmeters in 14 buildings. William Weigel, Captain-Quartermaster.

Washington, D. C.—On May 23 the Bureau of Supplies and Accounts will open bids for furnishing the Mare Island, Cal., and Puget Sound, Wash., Navy Yards with the following: Schedule 204, motors, incandescent lamps, telephone cord, etc., battery cells and carbons. Blank proposals can be obtained at the Navy Pay Offices in San Francisco and Seattle, or of the Bureau.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15@15⅛c.; Lake 15⅛@15¼c.; casting, 14¾@14⅞c.

The net earnings of the Electric Company of America for the past year were $408,901.

Stockholders of the Interborough Railway Company of New York hold their annual meeting May 10.

General Electric declined 10 points and Westinghouse 4 points in last week's dealings on the New York Stock Exchange.

New corporations formed in the Eastern States during April with a capital of $1,000,000 or more had a capitalization of $180,000,000.

It is said that the United Metals Selling Company will reduce its copper prices another ⅛ cent per pound to-day, making its official prices 15 cents for Lake, 14⅞ for electrolytic and 14⅝ for casting.

Charles D. Barney & Co., of Philadelphia, has purchased $1,750,000 of Lake Shore Electric bonds above 90. These bonds were taken up by a syndicate of Cleveland, O., banks at the time of the Everett-Moore troubles.

The Stanley Electric Manufacturing Company, with office in Jersey City and works at Pittsfield, Mass., filed an amendment of certificate with the Secretary of State of New Jersey reducing its capital stock from $4,000,000 to $2,300,000.

The Shawinigan Water & Power Company of Montreal, Canada, has just disposed of $4,000,000 of its first mortgage 5 per cent. bonds of an authorized issue of $5,000,000. New York and Boston capital is largely interested in the company.

The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent. on its preferred stock, payable May 15. Books close May 5 and reopen May 16. The board took no action on the common dividend, which, if the payment of a semi-annual disbursement is to be maintained, is not due until July 1.

Announcement has been made in Detroit of the sale of the Jackson & Battle Creek Company's third rail electric line by C. M. Spitzer, of Toledo, to a syndicate of Michigan men—Myron W. Mills and George G. Moore, of Port Huron, and James R. Elliott, of Lansing. The line is 48 miles long and two years ago cost $1,500,000.

The transfer books of the Havana Electric Railway Company will be closed from May 20 to May 25. Stockholders of record May 20 will have the right to subscribe for bonds and stock of the Havana Central Railroad. This company has been organized to construct about 120 miles of electric railroad radiating from the city of Havana, Cuba.

A certificate of increase of capital stock of the Interborough Railway Company of New York was recently filed. The certificate states that the capital stock is increased from $400,000 to $5,000,000. The stockholders who signed are Alfred Skitt, Cornelius Vanderbilt, Andrew Freedman, G. W. Young, John H. Schofield, Arthur Turnbull, William J. Fransiola and Walter Luttgen.

The Fitchburg & Leominster and Leominster, Shirley & Ayer (Mass.) Street Railway Companies, which were authorized Friday last to consolidate, will form the nucleus of a new air line electric system between Fitchburg and Boston. The new company, which proposes to operate between these two centers, will be capitalized for $1,500,000 and the construction of 27¾ miles of double track from Ayer to Cambridge, the eastern terminus of the line will, it is estimated, cost $2,000,000.

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Apr. 29
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	202
Manhattan Elevated Railway	161¼
Metropolitan Street Railway	115
Metropolitan Securities	75¼
Ninth Avenue	197
Third Avenue	124
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	59¼
Brooklyn City Railway	240
New Orleans Railway	4½
Public Service Corporation (New Jersey)	121
Philadelphia.	
Consolidated Traction of New Jersey	83¾
Philadelphia Traction	99¾
Union Traction	60¼
Boston.	
Boston Elevated	158½
Massachusetts Electric Companies, com	17
do. do. do. pref.	66
West End Street, com	97½
do. do. do. pref.	117
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	8½
do. do. pref.	45
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	14¼
do. pref.	54
Electric Boat, com	37
do. do. pref.	78
Electric Lead Reduction	½
Electric Vehicle, com	12½
do. do. pref.	20
Westinghouse, com	170
do. pref.	190
General Electric	171
Boston.	
Edison Electric Illuminating	253½
General Electric	171
Westinghouse Electric & Mfg., com	91
do. do. do. pref.	96
Chicago.	
Chicago Edison	165
National Carbon, com	62
do. do. pref.	114
Philadelphia.	
Electric Company of America	12
Electric Storage Battery, com	81
do. do. do. pref.	81
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	142
Western Telephone Company	18½
New England Telephone Company	139
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210½
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93
Chicago Telephone Company	137½
MISCELLANEOUS STOCKS.	
Otis Elevator Company	52
Consolidated Car Heating	64
Standard Underground Cable	200

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—AND—

Cedar Streets.

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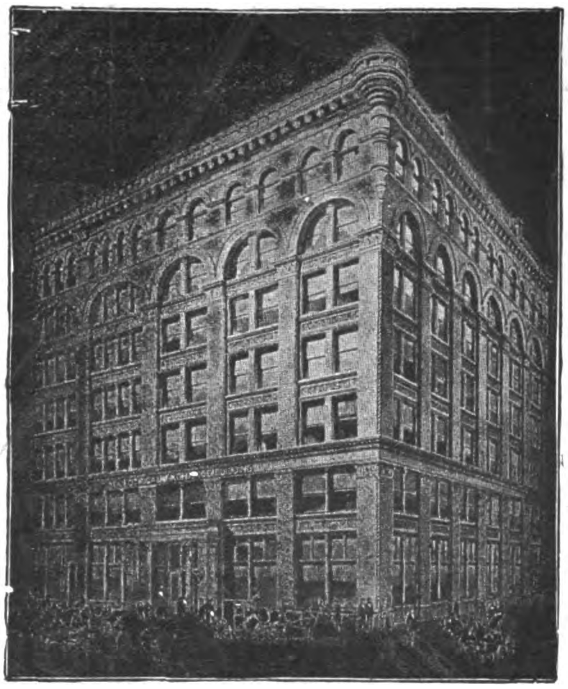

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FOR $15 PER MONTH

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—AND—
ELECTRIC LIGHT.

Liberty, Cedar and Washington Streets,
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APPLY TO SUPERINTENDENT ON THE PREMISES. TELEPHONE 5989 CORTLANDT.

NORTON SWITCHBOARD INSTRUMENTS.

NORTON VOLTMETER
10 30 50 70 90 110 130 150
THE Norton
ELECTRICAL INSTRUMENT COMPANY
No. 6953
MANCHESTER, CONN. U.S.A.

Style "C" in Ranges:

0 to 5 volts.
0 to 750 volts.
0 to 10 amperes.
0 to 1500 amperes.

NORTON AMMETER
10 30 50 70 90 110 130 150
THE Norton
ELECTRICAL INSTRUMENT COMPANY
No. 4855
MANCHESTER, CONN. U.S.A.

Dead Beat and made for either Back or Front Connections.

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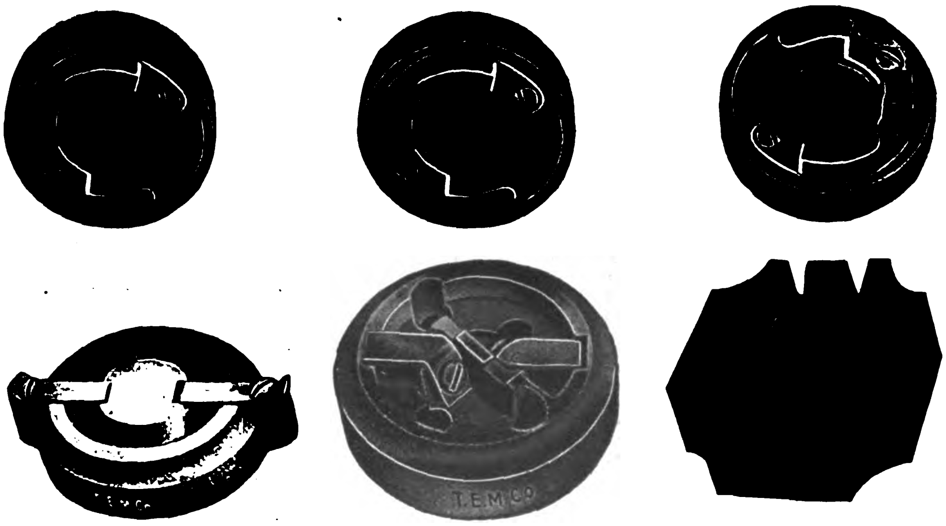

NEW FUSELESS ROSETTES

Appreciated by all who have to do with wiring. May be fitted with cord and snapped on after the base is in position by merely a quarter turn of the wrist. Notice the stop in the cap. It can be put on only one way, so that in arc-light work there is no possibility of reversing the current by taking off the rosette cap.

CAPS INTERCHANGEABLE. FIT EITHER STYE OF BASE

Hole in cap takes new code cord. Sample sent prepaid.

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THE TRUMBULL ELECTRIC MFG CO.,

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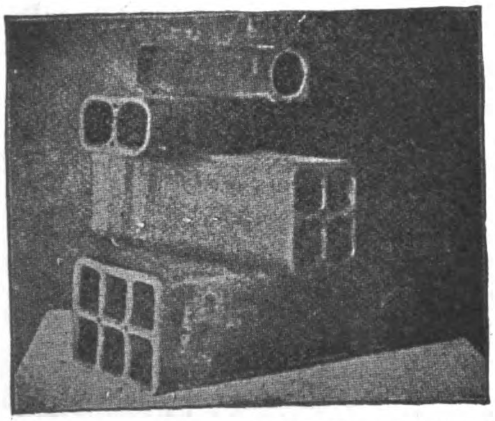

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EDITORIAL NOTES.

The Electric Lighting Situation.

Last week several bills bearing on the price of electric current in Greater New York were passed by the Legislature. One provides for $90 a year arc lights for Brooklyn, another reduces the price of electric current for private consumers to ten cents a kilowatt hour in Manhattan and to twelve cents in Brooklyn.

A commission of three will be appointed by the Governor for a term of years to see that the law is carried out and to supervise things in general.

The schedule of rates for electric current, which has been in force in this city for several years, is fifteen cents per kilowatt hour for the first two hours of use. For the third and fourth hours the charge has been ten cents per kilowatt hour, for the fifth and sixth, seven and one-half cents, and over six hours, five cents.

These figures do not seem exorbitant when it is borne in mind that a large amount of good machinery and apparatus has to be thrown in the scrap heap frequently after but a few years' use, in order to keep step with the onward march of progress.

The action of the politicians at Albany would certainly seem drastic and leaves the electric lighting companies throughout the State at the mercy of a commission with sweeping powers. This commission has greater authority to enforce its orders than any other commission ever created in New York.

Upon the complaint of any city, town or village authorities or of one hundred customers of a gas or electric company, the commission is directed to investigate the affairs of the company. After a hearing has been given, the commission, "within the limits prescribed by the law, may fix the maximum price of gas or electricity which shall be charged by such corporation or person in such municipality, or may order such improvement in the manufacture or supply of such gas, or in the manufacture, transmission or supply of such electricity, or in the methods employed by such person or corporation as will, in its judgment, improve the service."

The price set by the commission shall remain the maximum price for three years. Either the corporation or the complainants may appeal from the decision of the commission to the Appellate Division of the Supreme Court, which may modify the order.

There are to be three commissioners, at $8,000 a year, for six year terms, and with power to appoint experts and inspectors.

The commission will "have the general supervision of all persons and corporations having authority under any general or special law to lay down or erect and maintain wires, pipes and other fixtures in, over or under the streets, highways and public places of any municipality in this State for the purpose of furnishing gas or of furnishing or transmitting electricity for light, heat or power."

It may investigate the quality of gas and the methods of gas and electric light and power companies and order such improvements as may "best promote public interests."

Full power to examine plants, books and witnesses under oath is conferred on the commission.

General control is given to the commission over all State and municipal officers whose duty it is to inspect meters.

No company can get a new franchise nor can any city construct a municipal plant without the consent of the commission. Unless the commission gives its consent no company can issue new stock or bonds and no franchise or right can be transferred from one company to another unless the commission affirms.

This arrangement is delightful from a political standpoint. It creates three new places at $8,000 a year each for faithful followers to say nothing of numerous minor berths for smaller fry.

And the people are willing to foot the bills and stand for it to save a few cents each month on the electric current they may use. It looks very much like robbing Peter, not to pay Paul, but a certain set of politicians.

* * *

Co-operation in Science. The science of radio-active metals on the one hand, and the science of surgery on the other hand, represent a co-operative force seriously entertained as a means of destroying to extinction the frequently fatal bacilli of cancer.

At a great and distinguished gathering in Germany of surgeons and physicians of note, the question brought up for discussion was the relative merits of the knife versus the bloodless effectiveness of radium-coated tubes inserted in the diseased tissue. The principle upon which such possibilities as the latter rest, is the influence of short and rapid ether waves or light on death-dealing germs.

It must be understood that conservatism is the watchword in medicine. Innovations are regarded with distrust, particularly when they belong to a field foreign to the physician's experience. For this reason the work of Finsen required the backing of the most powerful of influences, no less than that of royalty itself, to reach a position in the eyes of the world that meant continued respect and appreciation. Light waves are exclusively employed for healing diseased flesh in this hospital addendum of Finsen's. The dignity and authority now possessed by the disciples of this creed are based upon the positiveness of many cures accomplished by the Finsen method. What is the basic principle of this or any other proposed cure to be carried out on these lines? What limit may be set to the possibilities involved in the broadest application of this new and fundamental idea?

The answer can best be found in the presumption of a variety of competent practitioners regarding the present drift of the problem. Curing by light means simply the limitation or elimination of germ cultures by exposure to light. Why this characteristic is peculiar to such infinitesimal micro-organisms has not as yet been answered. It is very likely that the effect of light upon the body of a microscopic life form is to produce a direct chemical change. The blind worm, sensitive to the light, can only exhibit a consciousness of this phenomenon, whether automatic or otherwise, through the influence of a chemical change caused by the light upon it. The lower forms of life are also proportionately affected, until as they descend to that ground base, the very bottom of the pyramid of life, a flood of light upon such delicate sparks of life as these means destruction. Thus, the foundation upon which anticipations rest, is fundamental with respect to germ life. But the great question which, as has been seen, is the one constantly recurring is of twofold form: first, what kind of light to use; second, how best to introduce it. It must be fully realized from this that what is called light is not necessarily visible to the human eye. Ether waves is perhaps a better, because a more general, expression to use with respect to such phenomena. They are as varied in character as those of any other medium, but unlike them, produce a gamut of effects unequalled in the whole range of physical science.

Our interest as human beings is peculiarly centered around the possibilities of light as a distinctly curative agent. It can hardly be believed that the natural condition of the body is other than that of perfect health. Medical science aided by the bacteriologist points to lapses as caused by germ life. If only these conditions are considered, which leave out accidental injuries of a vital nature, the possibilities of radium or light cures are enormous. The successful issue of such experiments lies with the bacteriologist and the electrician. Co-operation in science is the only means of searching for this panacea, and we are glad to see the seriousness with which common interests are united in the tests of its efficacy. No greater triumph could be yielded by this age than one which means restoration to health of thousands doomed by a malignant and fatal disease to read the blackest page in life. Radium, it must be understood, may not possess the qualifications to finally solve the problem of cancer cure; but at least this will remain, a principle of science on which such cures depend; and on this basis alone co-operative effort may ultimately attain the noble end for which it seeks.

Mayor Dunne, of Chicago, says he will not pay more than $50,000,000 for the railway systems of that city. In his campaign speeches, he placed the figure at which he thought the properties could be acquired at $77,000,000. He bases his last estimate on reports made by experts.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Copper producers hold prices of both electrolytic and Lake copper firm at 15 cents, but second hands are shading the price of electrolytic to 14⅞ cents.

Notwithstanding the opening of the New York Subway, the Metropolitan Street Railway Company's earnings for April were only $10,000 less in gross returns than in April, 1904, such has been the development of traffic in New York City.

Both Houses of the Illinois Legislature have passed bills giving the city of Chicago power to sell to private consumers for heating purposes surplus electricity from municipal electric lighting plants.

The National Electrical Contractors' Association will hold its convention and exhibit in Boston, July 15-22. For this purpose the entire Mechanics' Building, containing 83,000 square feet of exhibit floor space, has been engaged.

It is announced that a consolidation has been effected by the Stanley Electric Manufacturing Company of Pittsfield, Mass., and the General Incandescent Arc Light Company of New York, under the name of the Stanley-General Incandescent Electric Manufacturing Company. The works and general offices will be at Pittsfield. The Stanley Company is controlled by the General Electric Company.

Cornell University's list of candidates for degrees in June shows 205 mechanical engineers (including electrical engineers), and eight masters of mechanical engineering in Sibley College.

A cable dispatch from Brussels, Belgium, states that a deal has been consummated in that city by which all of the lighting companies of Rio de Janeiro, Brazil, have been acquired by the Rio de Janeiro Light, Power & Tramway Company, a large American Corporation having $50,000,000 capital. Some time ago the street railway lines were acquired, so that the company now has a monopoly of the light, heat, power and street railway business in the Brazilian capital.

MAINTENANCE OF METERS.*

BY W. J. MOWBRAY.

To the company supplying electric energy which is measured by meters and charged for accordingly, the maintenance of meter accuracy is of supreme importance. Losses in other apparatus become insignificant when compared with the loss of revenue from meters that are allowed to follow their natural tendency to run slow. For example, in a steam boiler a drop of 10 per cent. from normal efficiency would be detrimental to approximately the same percentage in the single item of the cost of coal, whereas in the metering system it would be 10 per cent. of the entire gross revenue to which the supplying company is legitimately entitled. Furthermore, if a metering system did actually deteriorate so as to record 10 per cent. less than the true energy, this loss would by no means remain constant; it would continue to increase.

Periodic overhauling is the obvious and generally adopted means of maintaining meter accuracy. Overhauling—a strict examination for correction and repairs—is efficient in proportion to the cheapness and accuracy with which it is done and to the permanence of the result. Means of making the result as permanent as possible will be considered later. Attention will first be called to a portable test meter used by the writer for the accurate and almost instantaneous determination of the percentage by which a meter is running fast or slow.

This meter is similar to a customer's ordinary watt-hour motor-meter in that it has a rotating armature, each revolution of which represents the passage through the meter of a certain number of watt hours. A rotating armature in a test-meter is advantageous in that its revolutions and those of the meter under test are directly comparable, making it immediately apparent whether the latter runs faster or slower than it should. Another advantage is that the comparison of revolutions is quite unaffected by fluctuations in pressure or current which would tend to render an indicating ininstrument unreadable because of the swinging of the needle.

The ampere capacity of this test-meter can be varied at will by means of a plurality of windings. To understand the utility of an adjustable carrying capacity it should be noted that a meter generally operates most accurately at full load and that as the load is decreased the meter is likely to become inaccurate. This is because it is impossible entirely to eliminate friction from the bearings and contacts of a meter armature or to keep this unavoidable friction at a constant value. Suppose this friction to vary sufficiently to cause an inaccuracy of 1 per cent. at full load and full torque, then at one-half load and one-half torque the proportion of this same friction variation to the torque would be doubled and the inaccuracy would also be doubled. Similarly at one-quarter load the inaccuracy would be increased four times, and at one-tenth load ten times. Suppose it be required to test a meter of 15 amperes capacity. On full load a corresponding 15 ampere winding of a test meter could be used with a high degree of accuracy. On a light load, however, say 1.5 amperes, both meters would be subject to the serious light-load inaccuracy above noted. In the latter case an adjustable ampere capacity in a test-meter can be utilized by changing, say from a 15-ampere to a 1.5-ampere winding, thus restoring the test-meter to full-load conditions of torque and accuracy. Meters of widely varying capacity have to be tested in practice and a test meter should accordingly be equipped with at least three different current windings and two different pressure windings.

A test-meter in use by the writer can be started or stopped at will by means of a switch, the meter under test meanwhile rotating continuously; in practice this test-meter is allowed to rotate only during the interval that the meter under test takes to make 1 or 10 revolutions. A comparison of the watt hours corresponding to the latter revolutions with the true watt hours as recorded by the test meter shows instantly whether the rate is fast, slow or correct. Explanatory of the relation between armature revolutions and watt hours, it may be noted that integrating watt-hour meters have what is called an armature or disk constant. Generally speaking, this armature constant in any particular meter is the number of watt hours corresponding to one armature revolution. Hence, the number of revolutions multiplied by the constant gives the watt hours. If either of these factors—revolutions or constant—be made equal to 1, 10 or 100, the multiplication necessary to obtain the watt-hours resolves itself into a mere shifting of the decimal point. Accordingly, in the case of the meter under test, 1 or 10 revolutions are taken and therefore the constant of that meter with proper location of the decimal point becomes equal to the recorded watt hours. The true watt hours can be similarly obtained from the revolutions of the test-meter, since in the latter the constants are arranged decimally, and it can at once be seen whether the consumer's meter records more or less than the true energy.

Accurate and cheap calibration is, however, of comparatively little value if a meter soon returns to its former condition of inaccuracy, therefore in old meters appliances should be provided for increasing the permanence of calibration. Owing to the advance of the art modern meters are fairly reliable, but their improvements are not generally applicable to the older forms. Suitable appliances have, however, been developed, chiefly by the large operating companies, with the result that meters manufactured some ten years ago can now be made at least equal in efficiency of operation to the most modern ones. Among the most prominent of these appliances are the adjustable friction compensating coil, the cupped, or concaved, diamond bearing and a means for correcting the disposition of the drag-magnets relative to the field coils.

The friction compensating-coil in operation carries a current of constant value and can be moved into such proximity to the rotating armature that its accelerating effect exactly neutralizes the retardation due to friction. Commutator friction increases very rapidly when a meter is first put in service but after a time it assumes practically a permanent maximum value. If at this time the compensating device be adjusted, a great part of the inaccuracy due to commutator friction will be permanently removed.

The cupped diamond bearing is partly the result of what has been termed by Lockwood the "cross fertilization of the sciences." Diamond being the hardest known substance, was long recognized as the most desirable bearing material, but it seemed impossible to get anyone to grind out a nicely curved and highly polished cavity in a diamond to receive the lower end of the vertical steel shaft. In the search for a new optical effect, however, the lapidary art has so developed that no serious difficulty is now experienced in satisfactorily cupping the surfaces of a diamond. As a meter-bearing it seems to embody the ultimate degree of perfection, the initial friction being a minimum and the wearing qualities a maximum. It is especially necessary in the old types of commutator meters with their very heavy rotating elements, because in these meters the material next in hardness to the diamond and which is generally used, sapphire, quickly breaks down in service.

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*Paper presented at the 196th meeting of the American Institute of Electrical Engineers. New York, April 28, 1905.

The object of changing the disposition of drag-magnets is to prevent meters from running fast after being subjected to the tremendous currents resulting from short circuits. In old meters the stray flux thus produced found a convenient path along the drag or braking magnets; this tended to demagnetize them, thus causing the meter to record more than the true energy. Van Vleck found by changing the disposition of the magnets so that the stray flux traveled across instead of along them, this effect was minimized and manufacturers changed their designs accordingly. Old meters can now be modernized in this respect by removing the magnets and attaching additional small bases thereto, the drilling of these new bases permitting the magnets to be remounted in the meter at right angles to their former positions.

In conclusion, it may be stated that this general system of overhauling has been productive of excellent results and is coming into extended use as the importance of maintaining meter accuracy becomes more fully realized.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

ELECTROPLATING, REFINING AND STERILIZING.

Treatment of Plated Articles.—The two courses of treatment to which the electroplater subjects articles undergoing plating may be classified as, first, that before plating for the purpose of securing electrical cleanliness, and second, that after plating in the nature of finishing. The following indicates this classification:

BEFORE PLATING.

Article may be washed in water, pickled in acid or scoured in lye.

AFTER PLATING.

Article may be scratched, buffed, polished or burnished.

Processes Before Plating.—Although cleanliness is above all the primary consideration, it is only obtained with respect to the surface of the metal by the use of vats of water, caustic soda and dilute acid. The surface of the article to undergo plating may have to be polished; it is then dipped in the hot lye solution to remove all traces of grease, then into the acid to remove any film of oxide present, and finally it is well washed in clean water.

Quicking Process.—When silver plating, one of the most prevalent platings in vogue, is in view, the copper surface is treated with mercury to secure a good foundation. A dilute solution of nitrate of mercury is applied, which forms a metallic precipitate suitable for the rapid and effective deposition of silver.

Processes After Plating.—The scratching, buffing and polishing of plated articles is a purely mechanical one. Its object is to remove metallic excresences, smooth the entire surface, and finally to give it the high finish looked for in such articles. The scratching is done by means of a wheel of brass wire projecting radially, which when rotating at a high speed acts as an effective scratch brush. The buffing is accomplished by the use of canvas wheels, composed of disks of canvas held at the center with the edges free. Buffing paste or powder is applied and marks of the scratching removed. The polishing is done by means of rouge or other fine polishing powders. The wheel may be of leather or walrus hide, by means of which a mirror-like surface is readily obtained.

Coloring Copper Surfaces.—A copper plating can be rendered artistic by the following means: To obtain a rich brown color, the object must be dipped into a very dilute nitric acid solution and heat gradually applied. By this process any shade of brown can be reached, which will possess great permanency. A fine black finish can be obtained by dipping the article into a weak solution of platinum chloride. This shade may be regulated by the strength of the solution and time of dipping.

Nodules on Plated Surfaces.—It is not necessary to employ more than a limited EMF. for plating; an EMF. which is different for each different metal used as an anode, or for each different bath. If too high a pressure is applied, but the supply of current is limited, a series of protuberances will appear. These nodules will dot the surface of the plating in a disagreeable manner and are entirely due to too weak a current at too high a pressure. A certain current per unit area of cathode surface is absolutely essential to correct results, the pressure of course not being excessive.

Cause of Stripping or Peeling.—One of the reasons why a dip into an acid bath is so necessary, or, as it is called, why pickling is employed, is to remove the oxide film which settles upon the surface of many metals and acts as a partial conductor to the current. Even though the conductivity of the surface be good, still there is no intimate contact between the coating and the cathode. Such a plating can easily "strip," that is, be peeled off. The removal of the oxide by polishing or by chemical means will insure a good deposit of metal. The pickling is always preceded by the lye solution, which if hot removes grease and, after washing, the acid solution follows.

Vats for Nickel Solution.—The nickel solution is frequently poured, after being made up, into wooden vats lined with lead. The lead joints are not soldered but burnt together. Nickel can be deposited on copper, iron, brass and steel by a solution in which the crystals of the double sulphate of nickel and ammonium have been dissolved. The crystals are green in color and may be procured in the way of regular goods from any electro-plating supply house. The vats are about 3 feet wide, 6 feet long and 30 inches deep, although the dimensions vary according to the work. Enameled vats are preferred by some platers because they possess strength, durability and insulating properties because of the coating. They are made of many sizes such as 1, 5, 10, 20 gallons, etc., up to 50 or 100 gallons capacity. All vats must have a rim of wood around the upper edge raised above the vat proper. The copper rods supporting the anodes and cathodes extend across, resting on this support.

Silver Salts and Solution.—Effects of a most artistic nature are obtained by a proper handling of a silver bath in electro-plating. The silver salts may be considered as represented by the chloride, nitrate, cyanide, acetate sulphide and oxide of silver. The cyanide of silver solution is used almost exclusively for silver plating and is made in the following manner: A solution of cyanide of potassium is carefully mixed, the preparation being made with well-filtered or distilled water. A solution of nitrate of silver is also carefully prepared under the same circumstances. The cyanide solution is then added slowly to the silver nitrate solution until a thick white precipitate is obtained at the bottom of the vessel. This white flocculent mass is washed with pure water several times until thoroughly cleansed. A new solution of cyanide of potassium is prepared and introduced gradually into the precipitate. The result of this operation will be the redissolving of the white mass and a new solution to which is given the name of "the double cyanide of silver and potassium."

Pointers in Silver Plating.—Successful silver plating can only be accomplished by patience and a strict adherance to the rules of cleanliness. The ultimate meaning of cleanliness with respect to the solution will be an ability to use the same solution *for years* if it is occasionally filtered or a little new cyanide added to replace or strengthen the old and make up for the losses due to evaporation. The following items of information are of value:

A good silver plating—the coating bright and natural looking.

A rough silver plating—the result of two much current.

A gray silver plating—the result of too much current.

A black silver plating—the result of too much current.

Distance Between Anode and Cathode.—If an object suspended from the cathode has many projecting parts presenting an irregular surface to the anode, considerable distance must be preserved between the anode and cathode. The advantages of this will be in a more uniform distribution of the current and consequently a more uniform coating of silver. The edges are apt to take on a rough deposit even under the best of conditions. The larger surfaces will plate very smooth and even unless very much curved. If the general character of the object being plated is curved it will be best to use an anode curved as far as possible in the same manner to obtain a fairly uniform series of paths through the liquid. In the plating of sideboard utensils, such as pitchers, sugar bowls, etc., the plating is only successful by means of special care in this respect.

The process of evenly plating statuettes or busts without destroying their contour is also a question of preserving equal current paths between them and the anode.

Iron Plating or Steel Facing.—For the steel facing of electrotypes or any other useful purpose, a coating of pure iron may be deposited from a solution made up as follows: "To each gallon of water dissolve one pound of carbonate of ammonium, and dissolve iron into the solution by passing a strong current from an anode of iron until a deposit appears upon a clean copper cathode. A few ounces of carbonate of ammonium should be stirred into the bath once a week. The anode, which should be large in proportion to the work, must be cleaned occasionally." Another solution employed for the steel facing of plates is made up as follows: "Prepare a solution of sulphate of iron, and another of carbonate of ammonium. Add the latter to the former until the iron is precipitated; pour off the liquid portion and wash the precipitate. Take a bulk of sulphuric acid equal to the volume of the solution required, and dissolve the iron precipitate in it to saturation. If there should be any free acid it will retard the working; it is therefore usual to evaporate the solution a little. From either of these solutions good iron can be obtained by a current of from three to four volts. The anode is always of iron, and the cathode of copper. The anode is from five to eight times larger than the cathode to prevent the solution from becoming acid. It is also advisable to have the anode in solution when not in use and to connect it by a wire to a cathode of platinum or copper to prevent the formation of acid and to keep the bath as dense as possible. The metal obtained is usually *as hard as steel*, but becomes soft and malleable after heating. It is very important to have a solution which yields a crystalline and very hard coating of iron. A coating obtained from a solution of sulphate of iron and chloride of ammonium yields an exceedingly hard deposit of the purest iron, and it is thus well suited to the coating of small and very fine electrotypes of steel engraved plates. Plates coated in this solution, have been known to yield as many as 10,000 impressions in printing, all sharp. All solutions made from sulphate of iron simply, are very troublesome and are constantly acted upon by the air, thus spoiling the solution. The salts in these solutions pass to a higher state of oxidation by absorption."—Urquhart. Air effects iron solutions rapidly, therefore they must be protected from the same as far as possible. Oxygen is rapidly absorbed and may appear in combination with the coating at the cathode. Charcoal iron is the purest to use as an anode, the next is wrought-iron in this respect. If the solution is slightly heated, it will act much better in plating work. Acid and ammonium carbonate can be added occasionally to compensate for the oxidized salts. This must be so carefully done that the general composition of the bath is not changed. When attempted by beginners this form of plating is full of holes, due to too much free acid in solution and a heavy current. Acidity can be held in check by the use of litmus paper for testing for this condition and when it is found to be present neutralizing it. An oxidized solution may be deoxidized by passing a current through it for some hours between an iron anode and copper cathode. A little glycerine may serve to protect the solution from the effects of the air, though a risk to employ.

Other Uses of Electricity.—The application of electricity to produce electrochemical changes is not limited to its use for the plating process alone. It is employed as the agency by means of which refining processes are carried out, germ laden masses of matter and infected water rendered innocuous, and new compounds produced. It is to be noted that electrochemical changes are those in which a transposition of atoms occurs without any other outward signs than perhaps those due to bubbles of gas. On the other hand, the use of electricity for the manufacture of new industrial products, such as aluminum or carborundum, is attended by the development of intense heat. This cannot be included in the category of electro-plating. It is evidently a phase of the use of the electric furnace. The applications of electrical energy may therefore be considered from these standpoints with reference to the production of such materials as follows:

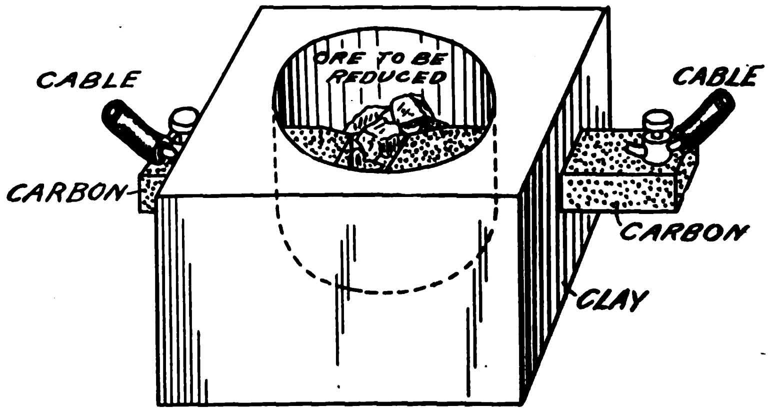
ELECTRIC FURNACE PRODUCTS.

1. Aluminum.
2. Carborundum.
3. Calcium Carbide.

ELECTRO STERILIZING.

1. Of drinking water.
2. Of city Sewage.
3. Of waste products for refilling ground.

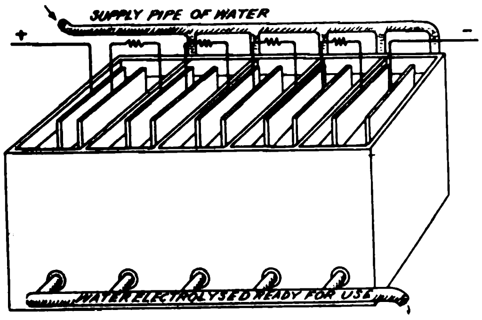
Aluminum.—This light, silvery looking metal can only be cheaply obtained by means of electricity. It is a distinctively electrical product in a commercial sense, derived from the electric furnace by the melting of aluminum bearing ore.



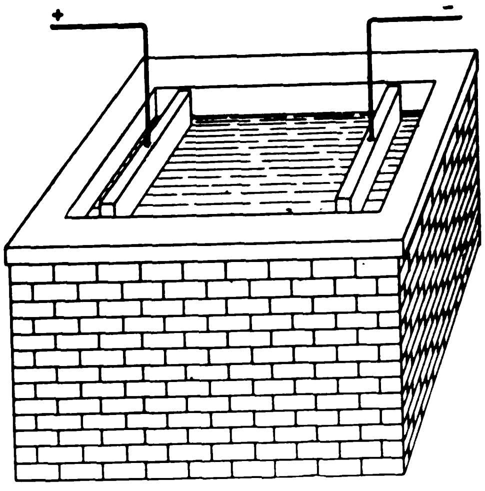
PRINCIPLE OF CONSTRUCTION OF AN ELECTRIC FURNACE.

The heat of the furnace and to some extent electrolytic action gives rise to the pure metal. The calcium carbide product, from which acetylene gas is obtained, is due to the coalition of lime and carbon in the electric furnace. Carborundrum is also obtained in a similar manner by the conjunction of two foreign bodies fused by heat into an industrial product. Thus aluminum the metal, calcium carbide the gas producing chemical, and carborundum, a substitute for emery, and superior to it, are the first practical yield of the electric furnace. In this furnace the molten mass is the result of the current passing through high resistances caused by imperfect contact and a rising temperature.

Electro Sterilizing.—It has been proposed on many occasions by scientists and inventors to sterilize the drinking water of large cities during plague periods by electricity. The germs of typhoid are peculiarly active in water, which in fact, is now considered as the most communicable means of establishing it within the system. Other germs may be transmitted in a more or less malignant form through the medium of water. Whether it can be proved directly or indirectly that this is the case, public sentiment requires as a measure of protection that the water be pure. To secure this end, it has been subjected to the effects of a current of electricity, the influence of which is dedestructive to animal life. That it undoubtedly renders the water under suspicion free from active germs has been substantiated in many cases. Though not deemed a practical process on a large scale, electricity has been employed to destroy the virility of germ life in sewage or other refuse utilized in many instances for reclaiming ground. The process is called filling in, and was carried out extensively at Riker's Island near Hell Gate, where the refuse was thoroughly treated before used for filling. The spread of disease is unquestionably due to the non-destruction of infected matter. This may be partly the result of bacteria in the air finding a suitable medium, or from the refuse of communities not provided with adequate sewage facilities. In this latter case disease cannot be stamped out unless either chemical or electrical methods of obtaining immunity are secured.

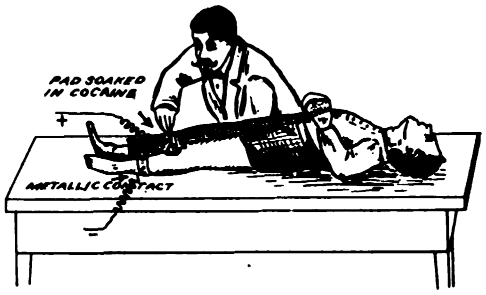


System employed for purifying water by electricity at a large packing plant in Jersey City.



Destruction of virulent germs in city waste by means of electricity.

Cataphorisis.—The transmission of a drug like cocaine from a sponge into the human body by means of electricity is entitled cataphorisis. If the negative pole of a battery is connected to the human body and the positive pole attached to an electrode in the form of a sponge or pad of absorbent cotton dampened with cocaine is applied to the gum or face, the region in contact with the positive electrode will become anæsthetized. The current carries the drug into the tissues freely and prepares them for surgical operations without hypodermic injection being necessary. In dental surgery this practice has been introduced to some extent by Dr. Morton, and on some occasions put into practice where other sensitive parts of the body have undergone operation. The current seems to carry the drug without difficulty and without chemical change into the tissues. Dr. Frederick Peterson conducted a series of exhaustive experiments in this field and established many interesting principles.



Producing local anæsthesia on the leg by means of cataphorisis.

Under the direction of the Bureau of Equipment of the Navy Department an electric telegraph "flash" was sent around the earth from Washington, D. C., on May 3 in two directions. A new world's record was established, the current encircling the globe in exactly seven seconds.

THE STARTING OF ROTARY CONVERTERS.*

BY SYDNEY WOODFIELD.

The method of starting rotary converters is a problem which merits every consideration on the part of the designer responsible for laying out large sub-stations. Capital cost, important though it be, should not be allowed to stand in the way of efficiency and a little extra capital may well be expended in securing the best method of starting promptly after the complete shut-down of a sub-station. As is well known, rotary converters are perhaps more satisfactory on low frequencies although they are built for 60 cycles with success. In methods where synchronizing is necessary it must not be forgotten that this is more easily done with low frequencies than with high, as, obviously enough, the beating of the synchronizing lamps will be about two and one-half times as frequent in the case of 60-cycle machines as it would be with 25-cycle ones and, furthermore, for the same time error in throwing in the switches, the former machine gets out of phase by an angle nearly two and one-half times as large as in the case of the lower frequency machine, assuming the same speed difference in both cases. Hence it will be seen that low frequency machines can be synchronized much more expeditiously than high frequency ones.

The following methods cover all that one is likely to meet with:

(a) Starting from the direct current end.

(b) By means of low voltage taps from the transformer.

(c) Compensator.

(d) Induction motor, i.e., mechanically.

(e) Running up with the alternator.

(f) Switching direct on to line.

Under (d) it should be noted, one includes all mechanical methods; for instance, all the machines could be fitted with pulleys and one run up from the other, the first machine being started by (e).

(a) This method is extremely simple, the rotary being run up as an ordinary direct current motor by means of a starting switch; the correct speed being obtained by field variation, using the ordinary field rheostat, the converter is then synchronized and put on the line. It is of course necessary to have direct current at a suitable potential available for starting the first machine and where a battery is located in the sub-station the case is considerably simplified. If there is no battery, an induction motor-generator of a suitable size will amply repay the slight increase in cost. In a large sub-station it is obviously undesirable to supply a starting switch for each machine; a small pair of bus-bars may be run the whole length of the rotary panels, and one starter used for the whole sub-station, as shown in Fig. 1. This arrangement permits of the first machine being run up and synchronized and thrown on the direct current bus-bars, the battery being again used independently for the other machines, or, if desired, any converter can be started from the main direct current bars. In the latter case, and also if the system is arranged as shown in Fig. 2, synchronizing becomes somewhat difficult at times owing to variations in the bus-bar voltage; moreover, the former connections allow of the battery being charged from any particular machine by means of a regulator, without complicating to any serious extent the alternating current board. If a battery is not located in the sub-station, the same wiring arrangement could still be used with the induction motor-generator, the generator taking the place of the battery in the diagram of connections.

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*From the "Electrical Review," London.

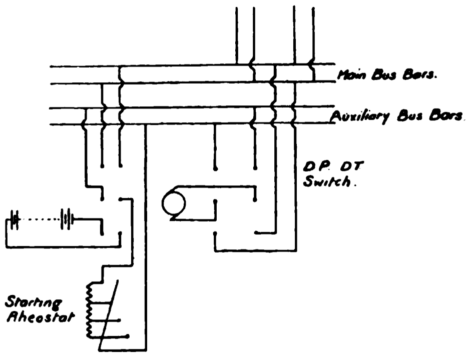

FIG. 1.

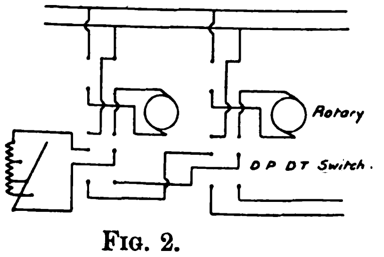

FIG. 2.

In the case of both three and six-phase converters (except with six-phase diametrical or double Y connections) the slipping brushes should be permanently connected to the transformer secondaries, without touching the alternating board at all. This is a very important point since owing to the low alternating potential the cables must be very heavy, and consequently, costly, and furthermore, the inductance of large cables is very high. It will be seen, therefore, that no low-tension alternating switches, ammeters, etc., are required and the low-tension cables are kept as short as possible, which tends towards increased efficiency.

Diametrical connections are now commonly used, as the higher voltage on the slip rings (the ratio .707 is the same as for a single-phase rotary, as against .612 for the "delta" connections) allows of lighter low-tension cables and only one secondary per transformer is required. With these connections, however, the converter cannot be started from the direct current end unless low-tension switches are provided, since, assuming the machine at rest, the commutator brushes may be resting on segments connected to bars which tap on to slip-rings 180 electrical degs. apart. In a two-pole machine, the two halves of the armature windings would be practically short-circuited by the secondary of one of the transformers, or shunted to such a degree as to make starting by this means commercially impossible. Under normal conditions of working it is better to synchronize, yet under exceptional circumstances—as, for instance, after a complete shut-down, one is anxious to get the current on the line again as quickly as possible. Under these circumstances the machine may be run up from the direct current end to a speed a little above synchronous speed, the direct current switches should then be pulled out and the machine thrown on to the alternating bus-bars without synchronizing. Care should be taken, however, to pull out the armature switches before the field switch, otherwise disastrous results will ensue. This method, as a rule, will cause no trouble if the system is fairly liberally designed or if the converter unit is small compared with the generator capacity.

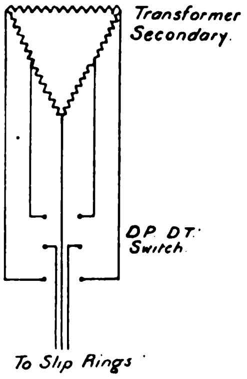

FIG. 3.

From the foregoing discussion it will be seen that starting from the direct current end gives very good results, in fact, it is perhaps the simplest and least expensive.

(b) The second method of starting, viz., by throwing the alternating current on to the slip rings at reduced potential, this lowering of potential being obtained by means of taps from the transformer secondaries as shown in Fig. 3. As is well known, the converter is self-starting from rest; when connected to the polyphase circuit it starts and runs up to synchronous speed. In converters having laminated field poles the effect is due to hysteresis, while in the case of solid poles, foucalt currents add to the starting torque by reason of their demagnetizing effects. The torque is produced owing to the attraction between the alternating currents of successive phases upon the permanent field of the induced currents which are brought into existence by the preceding phase. It will be seen, therefore, that the torque is but small, and, as a rule, about three times full load current is required to start the converter from rest. Since the large starting current which lags in phase by a considerable angle would, if drawn from the line, produce a large drop of voltage in the lines and entirely upset the regulation, besides being detrimental to the running of other plant on the circuits, taps are brought out from the secondaries of the transformers, giving one-half the normal slip-ring potential, thus allowing the machine to start up with about one and one-half times full load current. From the diagram of connections it will be seen that a double-pole double-throw switch is required between the transformers and the slip-rings, and moreover, two extra heavy cables must be brought from the secondaries to the switch. It becomes, therefore, important to locate the transformers and switch as near together as possible in order to reduce the length of cable required. At starting the field circuit is to the armature as the secondary of a transformer to the primary, and since the field turns are very large in number compared with the armature turns, an excessive potential would be induced, reaching, perhaps, 20 times the potential across the slip-rings. In order to prevent this induced potential the field winding may be short-circuited on itself, or what is preferable, should be subdivided up by means of a multi-contact switch so that, say, each pair of poles have the spools isolated and open circuited in one position, while all spools are connected in series for normal running in the other position. It must be remembered that the induced potential will be considerably higher in machines with laminated poles than it would be in the case of one with solid poles.

If the converter is compound wound, care must be taken to see that the series winding is also open. Since the EMF. of the brushes on the commutator is at starting an alternating one with the frequency of slip below synchronism, it follows that the converter may drop into synchronism at either polarity; if the polarity is wrong, the switches should be pulled out and a new trial made, or if another source of current is available, the converter may be separately excited in the reverse direction to its own excitation; this will cause it to slip a pole and consequently give the right polarity.

This system of starting excellent as it may appear, due to no synchronizing being required, possesses the drawback that extra low-tension cable is required, and also a large double-pole double-throw switch, and moreover, the length of low-tension cable cannot be kept as short as when the slip-ring brushes are connected directly to the transformers. In the larger sizes of machines which are now designed for six-phase operation (owing to the large increase in capacity, a three-phase machine has an output of 34 per cent. and a six-phase 96 per cent. greater than an equivalent direct current generator, the copper losses being the same in each case), it becomes practically impossible to use this system of starting and if no direct current is available the induction motor method must be employed. From the foregoing it will be seen that this way of starting is, as a whole, good, as no synchronizing is required; but other considerations make it somewhat expensive, and the fact that one can never tell which polarity the converter may take, gives it an element of uncertainty, although by means of a voltmeter an experienced attendant can generally manage to throw in the field switch at the right moment.

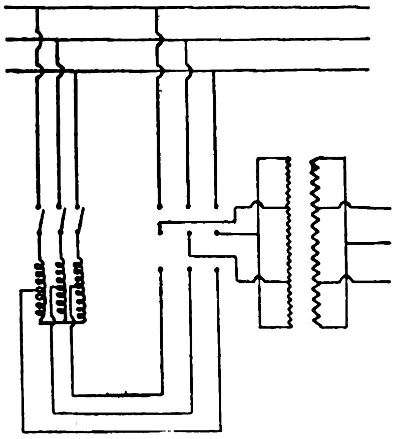

FIG. 4.

(c) The compensator method of starting acts to all intents the same as the previous method, viz., by reducing the impressed EMF. on the converter slip rings. The mode of reducing the voltage, however, is different, a compensator being used, this piece of apparatus being usually located as shown in Fig. 4, between the high tension lines and the transformer primary. The double-throw switch having to handle a small current can with the compensator be located in the most convenient position, while the large low-tension alternating cables can be kept as short as possible, as no low-tension alternating switches are required. Generally a couple of compensators may be used in a sub-station, arranged in such wise that either can be used for starting any machine.

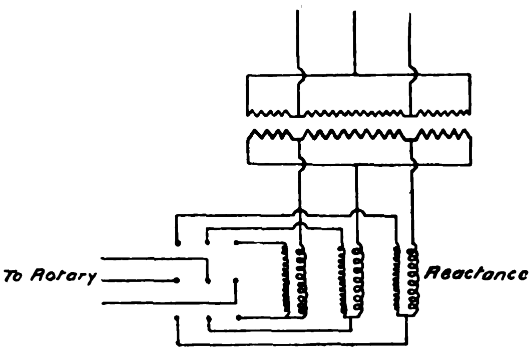

FIG. 5.

From the foregoing it will be noticed that this method possesses all the good features of the previous way of starting, more especially in not having to synchronize, and at the same time gets rid of some of the defects in the previous method, viz., the large low-tension switch, etc.

A method but rarely used is shown in Fig. 5. As is well known, the ratio of the alternating to the continuous potentials of a converter is practically constant, and in order to vary the continuous potential the applied alternating potential must be varied, a certain amount of reactance is therefore put in the alternating lines as shown in the diagram and by varying the converter field the current is made to lead or lag, thus giving a rise or a drop of potential.

The reactance is wound with two coils per core. At starting the two windings per leg are put in series by means of the double-throw switch, while for running the second winding is cut out, the transformers being connected through the single reactive coil to the slip rings.

(d) This method is largely used and is a purely mechanical one. A small induction motor is usually supplied with its rotor keyed on to an extension of the rotary shaft, the stator frame being bolted to the bearing pedestal. The stator is wound with a smaller number of poles than the rotary so that it runs at a somewhat higher speed. After the motor has been switched on to the line and run up to speed, the rotary field switch is closed and the converter excites itself; the speed of the set is then reduced to the synchronous speed by loading one phase of the rotary by means of a special rheostat supplied for the purpose. The induction motor varies in size with the capacity of the converter but is usually 6 to 10 per cent. of the full load output. This method only takes a small current from the line and is therefore not likely to upset the regulation; moreover, only small cables are required between the slip-rings and the transformers or the live side of the low-tension alternating main switches. This is a point of considerable importance as in large sizes of machines in some lay-outs the cost of cables more than balances the cost of the induction motor. This method, however, labors under the disadvantage that one cannot connect the slip-rings direct to the transformers unless a special starting transformer is used. There is no reason, however, why this should not be done as the cost would be very slight and the advantages considerable.

Taken as a whole, this method is one of the simplest and least difficult to operate and a smart man can have the set run up and synchronized in a very short time.

(e) This method of running up the machine with the alternator is an ideal way as it obviously is the one giving least strain to the plant but, unfortunately, it is commercially impracticable except in the case of the first converter to be run up.

The mode of operation is to leave the high-tension switches to the transformer primaries as well as the secondary closed so that the converter is always in synchronism with the alternator from the start. Just as soon as full speed is reached, the field switch may be closed, and if of the right polarity, the machine can be put on the direct current bus-bars.

(f) As a rule, only small machines can be thrown directly on the alternating bus-bars, for, as already explained, the disturbing effect on the system with a large machine would be prohibitive; it is therefore unnecessary to discuss this method further.

From what has been said it will at once be evident that, starting from the direct current end is preferable in all cases where it can be arranged for, and, failing this, especially with large six-phase machines of high frequency, the induction motor method is practically the only one available. However, each particular scheme is somewhat controlled by local conditions, and therefore no hard and fast rule should be adhered to.

NOTES ON THE USE OF INSTRUMENTS ON SWITCHBOARDS.[*]

BY F. P. COX.

The object of this paper is to invite discussion on what seems to be the more important features of instrument engineering, and its value to the Institute should be found in the discussion rather than in the paper itself.

In selecting instruments for any particular class of service the conditions under which they are to be used must be given careful consideration. It is evident that the conditions on a central-station switchboard will not permit of the same accuracy as could readily be obtained in a laboratory, and the information to be derived from the instrument readings does not require so exact a determination of values For example, consider a shunt ammeter; an instrument best adapted for laboratory conditions would have a shunt loss too great for switchboard service, and one designed for switchboards would have temperature errors so great that its use in the laboratory could not be contemplated. It is the author's intention to confine these notes to the conditions which are found on switchboards in central stations.

One of the most important considerations is in connection with the capacity of instruments to be used, and present needs cannot be altogether overshadowed by possibility of future growth. An ammeter whose needle constantly hovers around zero position is of comparatively little use, and an integrating wattmeter, which normally operates at 10 per cent., and frequently at less than 1 per cent. of its rated capacity, may give a false impression of the operating efficiency of the station. Under such conditions agreement is difficult to obtain, where totality meters are used and an effort is made to check them up with the sum of the individual feeders. Better results would be obtained by metering each generator, for under these conditions the meters would not be required to operate upon as low loads as they would if placed upon the feeders.

The friction of a jewel-bearing is generally considered so small that it may be neglected, but it must not be forgotten that a torque of 25 millimeter grammes is a little less than one five-thousandth of a foot-pound, and friction must be very small indeed if it is negligible as compared with this torque. Under normal working conditions, integrating instruments frequently operate at much lower torque, and even at full scale indicating instruments never approach this value.

It must also be remembered that the vibration of the board tends to impair the perfect polish of both jewel and pivot, and thus affect the accuracy of the readings. Other things being equal, it is apparent that these errors will be minimized by high torque, but they must not be altogether overlooked even under the most favorable conditions.

In deciding upon the capacity of an instrument it is necessary to take into consideration the relations between the smallest load, which it is desired to read, and the peak. It is generally considered advisable on railway circuits to have considerable overload capacity and but little attention is paid to the light-load period. On lighting circuits, however, the overload is not considered to be as important as on railway circuits and the light load is given more attention. It is usually good practice to select instruments of such capacity that under normal working conditions the needle of an indicating instrument will rest between one-half and two-thirds scale. This allows a reasonable capacity for growth and for overloads and at the same time permits of sufficient accuracy during the light-load period.

Integrating instruments should be fully loaded under normal conditions for they have an inherent overload capacity not possessed by indicating instruments; such practice insures not only low-load accuracy but also a reasonable dial registration over comparatively short periods of time. Where hourly or even daily readings of the dial are recorded it is not necessary that the registering train should have a capacity sufficient to care for several months' output. A rapidly moving dial-train permits full advantage to be taken of the meter's accuracy, and a change of one or two figures should be recorded for each observation period.

Accurate records necessitate occasional calibration and adjustment of switchboard instruments and suitable arrangements should be made for conveniently doing this work. Too little attention has been given to this feature in the past. It is frequently very difficult and sometimes impossible to introduce standards in circuits for calibration purposes. Perhaps this is a matter which should come under switchboard design rather than under instruments, but it is one of great importance and should be very thoroughly discussed.

Stray fields are always present in central stations and are frequently so strong that they cause marked instrument errors. In locating instruments on the board it is not sufficient to allow for position of bus-bars in relation to the instruments themselves, but the location of the iron framework of the board must also be taken into consideration. Magnetic fields have been carried by such iron frames and have introduced errors in instruments located many feet from the bus-bar itself. Such errors may be almost entirely eliminated by properly shielding the instrument, and no error need be introduced on account of residual magnetism or hysteresis of the iron shield. Properly designed instruments of this class show no appreciable difference between ascending and descending scales or between alternating and direct currents, and they are entirely unaffected by fields which would influence the readings of unshielded instruments as much as 10 or 15 per cent.

The use of series transformers, even on circuits of comparatively low pressure, seems to be increasing; the added convenience in removing or in cutting out instruments for recalibration, and the added security for the operators, more than compensate for the slight errors introduced by their use. This practice is particularly to be recommended in those cases where both sides of the line are brought into the same instrument, such for example as the polyphase, integrating or indicating instruments. It is also a good practice to interconnect the stationary and moving circuits and case of indicating instruments, and very often this would hardly be practicable unless series and pressure transformers are used.

Commutator meters are the only ones available for measurement of direct current; properly equipped with cupped diamond jewels, and occasionally corrected for commutator friction, they give excellent results. But induction meters with light moving element and no commutator are to be preferred wherever their use is possible.

Balanced three-phase circuits may be accurately measured by a single-phase wattmeter with a Y box. An instrument of this character records three times the energy of the phase in which the current coils are connected, therefore it should be used only in those cases where there is no possible question as to the circuits being exactly balanced.

Polyphase instruments, both integrating and indicating, are to be preferred even for balanced circuits, and for unbalanced circuits they become a necessity. Professor Nies advocates the use of three independent single-phase meters. Of course the resulting records of the different phases are interesting, and on a balanced circuit any material difference in the readings of the three instruments would indicate an error in one of them and serve as a warning that recalibration is necessary, or that the circuit has become accidentally unbalanced. In any case, it indicates a necessity for investigation. Still it is very doubtful if these advantages are sufficient to offset the added expense of three instruments and the space required on the switchboard for their installation.

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[*] Paper presented at the 196th meeting of the American Institute of Electrical Engineers, New York, April 28, 1905.

In the measurement of polyphase circuits, the greatest care should be taken to see that the instruments are installed exactly in accordance with instructions received from the manufacturer. Sometimes a slight deviation from the connection shown on the diagram to connections which seem to be equivalent introduces considerable error, due to the instrument coils being in wrong phases; instruments are not infrequently charged with errors which should properly be attributed to incorrect connections.

THE N. E. L. A. CONVENTION.

Denver and Colorado Springs Committees Preparing Many Surprises for Delegates and Friends—Secretary Farrand's Latest Bulletin.

Denver, Col., May 3.—The approaching convention of the National Electric Light Association, which meets in Denver the week of June 5, bids fair to be the most successful ever held by the association. A splendid programme has been prepared and there is every reason to expect that the delegates will be treated to many rare surprises such as can only be furnished in the Rocky Mountain region.

The delegates will arrive here on June 5. An entertainment will be provided for them at the Brown Hotel in the evening. The business sessions will begin the following day and will cover a period of three days. There will be a few night sessions.

The feature of the programme of entertainment will be the broncho-busting contest. An old cow puncher who has been riding the range for 40 years has the contest in charge. He will have 30 of the worst "outlaws" in the Rocky Mountain region and the horsemanship of the most skilled riders of the West will be severely tested by the bucking ponies. One of the "outlaws," which will be imported from Wyoming, has never been ridden. All the cowboys in the vicinity of the ranch where he is have tried to ride him, but no man has been able to hold his seat more than a few minutes.

The ladies will be entertained by the women members of the Country Club on one afternoon of the time the delegates will spend in Denver. All kinds of novel amusements are being planned for that afternoon and the visiting ladies will be able to carry away pleasant memories of the day. The club boasts one of the finest golf courses in the country and the guests of the club will be given the opportunity of playing over the links.

The visitors will be given a smoker, one of the biggest halls in the city having been hired for this event, and the committee in charge of the matter promises that the affair will furnish a lively entertainment for the evening.

Denver will be deserted by the delegates Friday morning when they will leave on special trains for Colorado Springs. Upon their arrival at the Springs they will be taken to the Garden of the Gods and other scenic points in carriages and automobiles. These trips are always greatly enjoyed by tourists, and it may be accepted that the delegates and their friends will enjoy the trips hugely.

Did you ever hear tell of Cripple Creek? Who hasn't? It is the greatest gold camp in the world and one of the most picturesque points in the Rocky Mountain region. On Saturday morning the delegates will be taken in a special train to this point over the Short Line Railroad. This road climbs a grade of over 4,000 feet and all the country within a radius of 100 or 150 miles may be seen from the train during the progress of the trip. All of the big mining properties of the gold camp will be visited by the party during their stay in Cripple Creek and Victor. Both of these places are exceedingly interesting from an electrical standpoint and doubtless the electrical men will take considerable interest in the stations at various points over the Cripple Creek district.

In the evening an entertainment will be provided at the Broadmoor Casino, a resort which has come into considerable enviable repute within the past few years. This resort is several miles outside of Colorado Springs and has a splendid golf course.

On Sunday there will be various optional trips. Many of the delegates will undoubtedly avail themselves of the opportunity of climbing or riding to the top of Pike's Peak.

On Monday the majority of the delegates will return to Denver. The railroads have arranged for several excursions on Monday and Tuesday. The rates will be low.

The following suggestions regarding railroad tickets will be of value: On the Union Pacific, Rock Island and Burlington, tickets should read through Denver to Colorado Springs; on the Santa Fe and Missouri Pacific, through Colorado Springs to Denver. In the first case there should be a stop-over at Denver, and in the second case a stop-over at Colorado Springs on the return trip. This does not mean any additional expense, and the railroads have agreed to the stop-overs. Low rates have been obtained, but they may go lower.

Special Train to Convention.

Arrangements have been made to run a special train of Pullman cars from New York to Denver via Pennsylvania line and Burlington route, leaving New York Saturday, June 3, and arriving at Denver Monday, June 5. This train will be a duplicate of the Pennsylvania Limited. Electrically lighted, parlor, smoker, dining and observation cars will be run via Chicago at which point it will be consolidated with a similar train being made up for the accommodation of Western delegates. Application for space should be made early as the lower berths are limited. Apply to Mr. George F. Porter, Master of Transportation, 136 Liberty Street, New York City, or to Mr. Colin Studds, Eastern Passenger Agent Pennsylvania Railroad, 263 Fifth avenue, New York City.

Secretary Farrand's Latest Bulletin.

Editor Electricity.

Sir: Should any of the members of the National Electric Light Association become impressed with the idea that sight-seeing and entertainment are to be the only features—or even the most prominent features—of the 28th convention, to be held in Denver and Colorado Springs, June 6 to 11, they are destined to disappointment.

President Davis has prepared a programme that will make the business sessions better attended than ever before and he intends to have the papers and reports fully discussed. Among the numbers already in press are the following:

Wrinkles, H. C. Abell, editor.
Question Box, Homer E. Niesz, editor.
The Nernst Lamp, Its Present Perform-

ance and Commercial Status, by E. R. Roberts.

Report on Purchased Electric Power in Factories, by E. W. Lloyd, chairman.

Report on Present Method of Protection from Lightning and Other Static Disturbances, by Alex Dow.

Some Investigation of Inductive Losses, by E. P. Dillon.

Insulation Testing Apparatus and Methods, by C. E. Skinner.

The Choice of An Insulated Cable, by Wallace S. Clark.

Sign and Decorative Lighting, by La Rue Vredenburgh.

Automatic Synchronizing of Generators and Rotaries, by Paul MacGahan.

Series Alternating Current Motors for Industrial Work, by Clarence Renshaw.

Long Distance High Tension Transmission in California, by John A. Briton.

Report of Committee on Progress, by T. Commerford Martin.

The Question Box is so voluminous that it seemed for a time impossible to get the cover on, but it has finally been closed and is in the hands of the printer. Mr. Abell reports about 120 Wrinkles, and about a dozen papers and reports are still to be printed, in addition to two or three reports that will be discussed in executive session and will not be in print.

The "flow of soul" that the entertainment committee is preparing will not be allowed to interfere in any manner with President Davis' "feast of reason" and every central station manager will be amply repaid for the time and money he may expend in attending the convention.

Very respectfully,
DUDLEY FARRAND,
Secretary.

Work of the Railway Congress.

The various sections of the International Railway Congress held two sessions in Washington Saturday. The delegates attached to the second section, which discussed locomotives and rolling stock, heard an extensive report by Mr. J. E. Muhlfeld, general superintendent of motive power of the Baltimore & Ohio, on high power locomotives. Mr. Muhlfeld explained that because of the rapid development of big engines, errors in design had been committed, which resulted in locomotives of huge dimensions, whereas greater power could be obtained with less size and weight.

The following permanent officers have been elected by the various sections of the Railway Congress:

First Section—Julius Kruttschnitt, fourth vice-president of Southern Pacific, president; M. Pontzen, Minister of Transportation, France, vice-president; M. Edouard Elskes, Switzerland, and C. H. Bucholz, consulting engineer of the Erie Railroad, principal secretaries.

Second Section—M. Sauvage, France, president; M. Mentsik, Hungary, and E. T. Jeffery, vice-presidents; M. Boel, France, and D. J. Crawford, Pennsylvania Railroad, principal secretaries.

Third Section—H. T. Hodgson, vice-president of the Midland Railway, president; B. L. Winchell, president of the Chicago, Rock Island & Pacific, vice-president; Charles Jenny, Austria, and A. W. Johnston, New York, Chicago & St. Louis Railway, principal secretaries.

Fourth Section—M. Emile Heurteau, general manager of the Orleans Railway, France, president; James Douglas, El Paso & Southwestern, vice-president; M. Margot, France, and C. Peter Clark, Buffalo & Susquehanna, principal secretaries.

Fifth Section—M. De Leber, Austria, president; C. M. Hays, second vice-president Grand Trunk Railway, vice-president; W. M. Acworth, Board of Trade, Great Britain, and C. G. Waldo, American Railway Association, principal secretaries.

Ohio Engineers' Meeting.

Mr. Corwin J. Miller, secretary, Canton, O., informs us that the tenth meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held at Toledo, May 19 and 20. An excellent programme has been prepared, among the papers being the following: "Losses in the Power Plant," by Charles W. Harvey; "Power Plant Supervision and Accounting," by F. W. Ballard; "Some Recent Improved Forms of Electric Lamps," by Prof. F. C. Caldwell.

Proposals Invited.

Sealed proposals will be received by the Department of Water of Oswego, N. Y., until May 18, 12 o'clock noon, for furnishing the necessary generators, motors, transformers and other electrical equipment for the lake water extensions. Specifications and blank proposal sheets may be obtained at the office of the Department of Water.

All proposals must be indorsed "Proposals for furnishing and installing electrical equipment for lake water extension and must be accompanied by a certified check on an Oswego bank or a New York draft for $1,000, payable to the Department of Water of the city of Oswego. The Department reserves the right to reject any and all bids. Address F. W. Ormsby, Secretary.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MAY 2, 1905.

Electric Railways and Appliances.

788,513. Railway Signal System. Abram L. Bower, Boyertown, Pa. Filed May 3, 1902.

788,526. Electric Trolley-Wheel. Theophile Euphrat, Norwalk, Conn. Filed Aug. 25, 1904.

788,536. Pneumatic Railway Signaling System and Electropneumatic Valve Therefor. Ernest C. Irving, Westminster, Eng., assignor of one-half to John Patrick O'Donnell, same place. Filed March 14, 1903.

788,562. Electrical Railway Signal. James W. Tatum, Durham, N. C., assignor of one-half to Robert B. Boone and John W. Smith, same place. Filed Oct. 19, 1903.

788,959. Electric Circuit and Apparatus for Railway Signaling. Henry W. Spang New York City, assignor, by mesne assignments, to Charles H. Ketchum, Yonkers, N. Y. Filed Aug. 21, 1902.

789,014. Trolley. Charles M. Feist, Sioux City, Ia. Filed Aug. 24, 1904.

Electric Lights and Appliances.

788,540. Electric-Light-Bath Cabinet. Richard Kny, Brooklyn, N. Y. Filed Jan. 3, 1905.

788,872. Automatic Electric-Light Connection for Automatic Railway Block-Signals. William Alloway, Caledonia, N. Y. Filed March 22, 1904.

788,990. System of Electric Car-Lighting. Richard D. Apperson and Albert J. Kohler, Lynchburg, Va. Filed March 24, 1904.

Electrical Machinery and Apparatus

788,518. Switch and Connection Controlling Electric Motors and Power-Transmitters. Herbert B. Coho, Mount Vernon, N. Y., assignor, by mesne assignments, of one-half to the Wheeler & Wilson Manufacturing Company and the Emerson Electric Mfg. Co., St. Louis, Mo. Filed Sept. 17, 1903.

788,566. Electric Motor and Power-Transmitter. Orville R. Van Vechten, New York City, assignor to Herbert B. Coho, Mount Vernon, N. Y., Wheeler & Wilson Manufacturing Company and the Emerson Electric Mfg. Co., St. Louis, Mo. Filed Sept. 17, 1903.

788 686. Resistance for Electrical Circuits. Hermon L. Van Valkenburg, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Aug. 6, 1904.

788,819. Electric-Motor Starting and Stopping Device. John H. B. Bryan, Buffalo, N. Y. Filed March 14, 1904.

788,875. Electrical Stop Mechanism for Looms. Frederick M. Armstrong, Pawtucket, R. I., assignor to the Kip-Armstrong Company. Filed July 26, 1902.

788,916. Electrical Switch Mechanism. Hubert Krantz, New York City. Filed Dec. 6, 1904.

Telephones and Telephone Apparatus.

788,924. Telephone-Switchboard Annunciator. Charles T. Mason, Sumter, S. C., assignor to the Sumter Telephone Manufacturing Company. Filed June 10, 1904.

Miscellaneous.

788,563. Means for Establishing Electric Circuits. Guion Thompson, Duluth, Minn., assignor to the Thompson Safety Appliance Company. Filed July 1, 1902.

788,704. Electric Striking-Clock. Ulysses L. Collins, St. Louis, Mo., assignor to the Collins Electric Clock Company. Filed Feb. 23, 1904.

788,728. Apparatus for Electromagnetically Receiving, Recording, Reproducing and Distributing Articulate Speech, etc. Valdemar Poulsen, Copenhagen, Denmark. Filed Aug. 14, 1901.

788,732. Electric Sparking Igniter for Gas or Gasoline Engines. Joseph P. Seaton, North Birmingham, Ala. Filed Sept. 19, 1903.

788,747. Electric Display Apparatus. Edmund L. Zalinski, New York City. Filed Oct. 6, 1904.

788,762. Electromagnetic Device. Albert Favarger, Neuchatel, Switzerland. Filed Nov. 25, 1902.

788,800. Telegraphy and Telegraph Apparatus. Wesley Trafford, New York City. Filed March 15, 1897.

788,905. Electric Heater. Harry M. Hill, St. Louis, Mo., assignor to the Hill Electric Manufacturing Company, St. Louis, Mo. Filed April 25, 1904.

788,917. Electrical Device. Hubert Krantz, New York City. Filed Dec. 6, 1904.

789,030. Electric Signal System. Robert O. Johnston, Brooklyn, N. Y. Filed March 30, 1904.

789,040. Electrotherapeutic Apparatus. Charles F. Marsh, Pensacola, Fla. Filed Dec. 3, 1903.

789,082-083. Safety Device for Electric Currents. McKelvey Crites, Cleveland, O., assignor of two-thirds to William S. Rogers and Oscar Textor, same place. Filed Sept. 22, 1904; Dec. 27, 1904.

THE TELEPHONE WORLD.

Big Telephone Deal Consummated.

The controlling interest in the Frontier Telephone Company lately passed by purchase to the Consolidated Telephone Company, of Buffalo, N. Y.

The Consolidated Telephone Company, with a capital stock of $10,000,000, owns and controls the Inter-Ocean Telephone & Telegraph Company, with a capitalization of $2,000,000, and some 50 other important telephone companies in that section of the State, and is one of the most progressive Independent telephone companies in the United States.

When questioned recently as to the benefits to the telephone companies interested, and the general public at large, by this deal, B. G. Hubbell, president of the Consolidated Telephone Company, said:

"The interests brought together through this transaction have produced a happy combination, which will greatly benefit the general public as well as the parties interested.

"The Consolidated Telephone Company, through its control of the Inter-Ocean Telephone & Telegraph Company, the long-distance telephone organization for the Independent interests of New York State, and its control of the Independent telephone business in all sections of this State and adjoining States, either by ownership of important exchanges or by exclusive contracts for connection with other exchanges and toll lines, occupies a position that will be of great benefit to the Frontier Telephone Company of Buffalo, while, on the other hand, it is conceded that Buffalo occupies the strategic telephone position of this section of the country, and the Consolidated Company, and its affiliated interests are, of course, to be congratulated upon gaining control of the Independent telephone business in Buffalo.

"The Frontier Telephone Company's switchboard has the largest multiple capacity of any switchboard in the United States; its underground work is extensive and extremely well-constructed and provides for the largest possible ultimate development; its apparatus and service is excellent, and everything has been done to make an extensive and permanent foundation for this most progressive institution.

"Through the competition afforded by the Frontier Company, the class of service has been improved over 1,000 per cent. or more; the number of subscribers to be reached has multiplied over five times the number prior to competition, and a business man can now have the service of both telephone companies, reaching over 25,000 subscribers in Buffalo, for actually less money than he was forced to pay for connections with less than 5,000 telephones prior or the organization of the Frontier Company."

It is predicted that as a result of the trouble in Herkimer, N. Y., over the telephone service and rates a special election will be called for the purpose of giving the taxpayers of the village an opportunity to vote on the question of establishing a municipal telephone system. The Herkimer Business Men's Association met recently and Village Attorney Hane made a report on the provisions of the franchise held by the County Telephone Company. It is claimed the company has violated its rights and that the village board can annul the franchise.

Government Will Put In Its Own Lines.

The Government is going into the telephone business in the western part of Nevada. Failing to make satisfactory terms with the Sunset Company, the Interior Department will build a line running from Lake Tahoe, the head of the Western Nevada irrigation system, to Fallon, by way of Reno. At Reno an exchange will be located, and from it will radiate lines to all of the main lateral ditches. The system will be constructed at once of the best materials, and will be used for Government purposes only. It was not the purpose of the Government to invade this field, and it was not until after the Sunset people declined to make what were considered reasonable terms that the matter was taken up.

The Lake George Telephone & Telegraph Company, of Lake George, N. Y., has a project on foot which will mean much to the cottagers and summer residents of the east shore of the lake. It is planned to extend the lines of the company from Shelving Rock to Camp Andrews owned by I. Lloyd Green, of Poughkeepsie, and on further, south to the hotels and cottages on Kattskill Bay and at Ripley's Point. The new line will bring within easy communication the numerous cottage owners near Victoria Lodge, about Shelving Rock, Kattskill Bay and Ripley's Point. The extension of the line in that vicinity means the outlaying of a large sum of money. The company, of which George O. Knapp, of Chicago and Lake George, is the owner, now owns a private line. The new line will be modern in every particular and the best possible service will be given the subscribers. At present there is but one line to Glens Falls. In the reconstructed line there will be strung an additional set of wires.

The executive board of the Western Illinois & Eastern Missouri Independent Telephone Companies met in Jacksonville a short time ago. Those present were Frank Buffum, of Louisiana, Mo.; Ed. Glanden, Pittsfield; E. R. Conklin, Aurora, and W. W. Halliday, of the Illinois Telephone Company. Matters pertaining to schedule of exchange rates were agreed upon and a book of rates and rules will be issued in the near future.

The North Shore Telephone Company, of Port Jefferson, N. Y, has filed with the Secretary of State a certificate setting forth that its capital stock has been increased from $7,500 to $10,000, consisting of shares of $25 each. The certificate is signed by Frank H. Tuthill and Charles V. Platt.

The Minnesota Central Telephone Company has recently completed the construction in Wheaton of an up-to-date telephone system. In the main part of the town the wires are cabled and the poles have been placed in the alleys.

The Farmers' New Era Telephone Company, of Hebron, Ill., has increased its capital stock from $15,000 to $30,000.

The Henry County Telephone Company, of New London, Ia., has increased its capital from $15,000 to $30,000.

Keystone Telephone people, according to a dispatch from Philadelphia, Pa., speak with confidence of the success of the present refinancing of the company. A representative of large stockholding interests says: "I expect the plans will be announced as consummated May 10. When recapitalized, the company will have $5,000,000 stock subject to the $7,000,000 bonds, a portion of which retire the present stocks, and the floating debt will be liquidated The company will then be in a position to retain or sell its extra conduit space as it may decide."

The directors of the Killawog, N. Y., Telephone Company met recently and elected the following officers: President, Charles Tarble, Killawog; vice-president, William Dickinson, Messengerville; secretary, C. A. Brooks. Marathon; treasurer, A. C. Adams, Marathon. When their time shall have been completed free service to the patrons will be given to Messengerville, Dryden, Virgil, McLean and other points north, and Killawog Lisle, and other points as far as Binghamton.

The Wisconsin Telephone Company is planning to build a two-line copper circuit from Madison to Stevens Point. The latter place will be the switch point for Grand Rapids, Eau Claire, Ashland and Appleton. Plainfield and Portage will be on the new circuit.

The contract for building nearly seven miles of subway in Utica, N. Y., by the Central New York Telephone Company has been awarded to Joseph Dunfee of Syracuse. The job calls for an expenditure of $65,000, besides the conduits and cables, which the company furnishes. A similar large amount of construction is to be started by that telephone company in Syracuse.

Seventy-five thousand dollars of the big appropriation for the improvement of the Iowa Telephone Company in that State will be expended during the coming summer in and about Des Moines. Eight copper wire toll lines are to be built from there in four directions. Five of these lines will run to Davenport, Fort Dodge, Sioux City, Ottumwa and Council Bluffs.

Judge Murphy, of Cincinnati, O., has set aside the judgment—Pogue & Pogue—held against the Fitzsimmons Telephone Company, and through Attorney Joshua M. Dawson has given Mr. Fitzsimmons leave to file an answer. The Fitzsimmons interests announce their determination to reorganize the company on a Fitzsimmons basis entirely.

The Napa, Cal., Telephone Company will soon spend about $10,000 in the improvement of its lines in a change from a ten-party to a four-party line.

The Pleasant Hill, Mo., Telephone Company has filed a statement to show that it had made an increase in its capital stock from $10,000 to $30,000; one-half the increase has been paid.

The Christian County Telephone Company, recently organized with a capital stock of $50,000, has been granted a 20-year franchise by the Taylorville, Ill., city council.

The Federal Telephone Company is going out of business in Westmoreland County, Pa

GENERAL ELECTRICAL NEWS.

LIGHTING.

Argentine, Kan.—The Santa Fe Railway Company will build a power house and electric plant sufficient to furnish power for the Argentine shops and light for the yards and offices. The work on the plant will probably begin within the next few months. The cost is estimated at $48,000.

Ballard, Wash.—The Ballard Electric Company has begun the extension of its lighting system in this city. Of the $30,000, which it was estimated would be required for the completion of the work, $13,000 has already been contributed by local stockholders.

Breckenridge, Mo.—At a special election a proposition to bond this city for $10,000, for the purpose of putting in an electric light plant, was carried.

Central Falls, R. I.—This city, which is supplied with light by the Pawtucket Electric Company, is determined to own its own lighting plant. The present contract with the Pawtucket concern will not expire for five years, but the city council has already secured an option on a site, and at its next meeting will probably make an appropriation for a suitable structure.

Columbus, O.—The Columbus Public Service Company will increase its capital from $250,000 to $1,750,000; the electric lighting capacity will be doubled.

Hartford, Conn.—The Hartford Electric Light Company has been authorized to issue bonds to the amount of $2,000,000, and to increase its capital from $1,600,000 to $3,000,000.

Heno, O.—The Middletown Electric Light & Power Company has received the contract to light the streets of this city.

Henry, Ill.—The Henry Electric Light & Power Company, with a capital of $20,000, has been incorporated by John H. Crickenberger, Fred W. Potter and others.

Howard City, Mich.—A 10-year franchise has been granted A. O'Donnell, of this city, by the council to furnish electricity for all uses.

Little Rock, Ark.—A company, capitalized at $250,000, has been organized here to install a new electric light plant.

Laurel, Ia.—The Laurel Improvement Company has accepted the franchise offered by the city, and will begin at once the erection and installation of a $25,000 electric light and power plant.

Oxford, N. C.—A charter has been issued to the Oxford Water & Electric Company with $50,000 capital, for the purpose of constructing waterworks and an electric light plant for this town. The incorporators are Harry L. Millner, of Morgantown; W. T. Sherman, of Washington, D. C.

Pelham, Ga.—The city council has granted a franchise to W. H. Maury for an electric light plant to be put in at once.

Pleasantville, N. J.—The Shore Electric Light Company is about to be sold at receiver's sale, and will probably be operated by Atlantic City capitalists.

Traverse City, Mich.—Preliminary legislation for the construction of a $50,000 electric lighting plant is about to be taken.

Wilmington, Del.—The Wilmington Electric Light & Power Company, with a capital of $1,000,000, has been incorporated by Horace W. Gause, Samuel K. Smith, Henry P. Scott and others.

Winfield, Kan.—The special election to vote on the proposition to issue bonds to the amount of $15,000 for completing the electric light plant was lately carried.

Wautoma, Wis.—This city is to have a special election on May 11 to vote for or against issuing bonds for the purpose of building and establishing a municipal electric lighting plant.

STREET RAILWAYS.

Appalachia, Va.—Capitalists of Big Stone Gap propose to build 100 miles of electric roads, and it is said they have begun surveys.

Auburn, Ind.—An electric line will be built in and through this city.

Brooklyn, N. Y.—Many new lines are to be established by the Brooklyn Rapid Transit Company, which owns a number of franchises for the operation of cars in the suburban sections.

Bryan, Tex.—The city council has granted a franchise to W. P. Connelly, J. W. Batts and others, to construct and operate an electric car line on the streets of this city.

Canton, Miss.—A. P. Cameron, of this city, with E. W. Brister and others have incorporated themselves into the Canton & Yazoo City Trolley Company to build a line connecting the two places.

Deadwood, S. D.—Articles of incorporation have been filed by the Black Hills Traction Company, with a capital of $400,000, to build an electric road from here to Belle Fourche.

Defiance, O.—The question of building an electric road from this city has been settled and it will be continued from Ann Arbor to Detroit, Mich.

East Hampton, Conn.—Promoters of the Salmon River Power Company are planning for a trolley route from this place. The road will cost $175,000.

Fort Dodge, Ia.—An electric line is proposed from here to Webster City, and thence south to Des Moines.

Gainesville, Ga.—The Gainesville Electric Railway Company has been organized here. A. J. Warner is president, and W. H. Slack secretary of the new company.

Goldfield, Nev.—The new Nevada camp of Goldfield is planning a local electric road. It is designed to carry both freight and passengers and will connect with the Tonopah-Goldfield railroad station and all of the mines of the camp.

Great Falls, Mont.—Franchises have been granted to Dr. E. Crutcher and associates, by the board of county commissioners of Cascade County, for the building of electric railroads all over the county. The same men will at once apply for franchises in Lewis and Clark, Teton, Fergus, Choteau and other counties. The scheme is reported to be backed by a strong syndicate of San Francisco and New York capitalists.

Ilion, N. Y.—The promoters of the proposed trolley line south of this place to New Berlin, have about half of their preliminary investigation completed, and report that between here and Cedarville there are but two or three places where railroad building would be above the average cost. The promoters have strong hopes that the road will become a reality.

Janesville, Wis.—The Southern Wisconsin Interurban Railroad Company will build a trolley line to Madison.

Lafayette, Ind.—An election will be held in Fairfield and Jackson Townships to vote on a 2 per cent. tax in aid of the Lafayette & Southwestern Traction Company, which proposes to build from this city to the Covington coal field.

Lawton, Okla.—It is announced that the railroad company recently chartered for southwest Oklahoma will build an electric line through the Wichita Mountains to Fort Sill and this city.

Mankato, Minn.—The Mankato and St. Peter Railway & Lighting Company is asking for a 20-year franchise to construct an electric street railway.

New Castle, Pa.—The Western Pennsylvania Motor Power Company has been organized by Pittsburg men to construct a huge system of interurban trolley lines throughout Lawrence, Butler, Mercer and Beaver Counties. The incorporators are Alexander J. Barron William G. Doolittle, Charles E. Martin, Edward L. Allen and Ralph L. Smith. It is said that connections will be made to Pittsburg.

Peoria, Ill.—According to the definite announcement of W. B. McKinley, of the McKinley Syndicate of Interurban Railways, this city will have trolley connections with St. Louis within a year. One of the promoters says that the bonds have all been subscribed for and that actual work is now under way for the proposed new road.

Rockefeller, Ill.—The Chicago & Milwaukee Electric Railroad Company will build its line from here to Waukegan.

Springfield, Ill.—The Marion & Harrisburg Electric Railway Company has been incorporated with a capital of $10,000.

Wabash, Ind.—The syndicate which is back of the Fort Wayne & Wabash Valley Traction Company has organized a company with $550,000 capital to build a traction line from Fort Wayne to Bluffton.

Walnut Grove, Cal.—The Southern Pacific Railroad Company is planning to build an electric line from Sacramento to this place.

Zanesville, O.—The Zanesville-Coshocton Electric Railroad Company, which proposes a route touching Norwich and New Concord, is making great progress in the vicinity of New Concord in securing the right of way. It has secured free way between New Concord and Norwich and is now working along the route east.

POWER PLANTS.

Elkhart, Ind.—C. G. Conn has sold his electric power plant here to the Indiana & Michigan Electric Company.

Prosser, Wash.—President E. F. Benson, of the Prosser Falls Land & Power Company, has filed a notice at the office of the county auditor of the appropriation of 5,000 cubic feet of water per second from the Columbia River, to be diverted at Priest Rapids, for the purpose of generating electric power at that point and transmitting the same to Prosser.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 14⅞@15c.; Lake 14⅞@15c.; casting, 14⅝@14¾c.

A financial agency of Philadelphia repeats its former assertion that the plan to lease the Electric Company of America has not been abandoned. An offer of a guaranteed dividend of 7 per cent. has been made.

Dissatisfied with the policy pursued by the receivers of the Chicago Union Traction Company and the lack of progress in improving the system, John C. Fetzer, managing receiver, has sent in his resignation to Judge Grosscup.

In the $2,000,000 mortgage foreclosure suit of the Hudson River Electric Company against the Hudson River Water Power Company, Supreme Court Justice J. M. Kellogg has appointed as receiver Charles Pedrick, of Glens Falls, N. Y.

The Consolidated Gas, Electric Light & Power Company of Baltimore is offering to buy its own minority stock, giving par in the general mortgage 4½ per cent. 30-year bonds, but stipulating that the bonds must be withheld from sale for a year.

The Hanover Light & Power Company was incorporated at Albany on Saturday, with a capital of $2,000,000, to operate throughout the State of New York. The directors are William C. Janney, E. G. Du Mazuel and Frank B. Pierce, of New York.

At a meeting in New York of Twin City Rapid Transit directors plans were discussed to finance 50 miles of new extensions and to arrange for classification of directors. It is understood that the financing will be done by issue of common stock, probably at par.

August Belmont & Co., Wm. A. Read & Co. and Lee, Higginson & Co. have purchased from the Interborough Rapid Transit Company of New York $10,000,000 three-year 4 per cent. gold notes, due May 1, 1908, and have disposed of the entire amount privately to investors.

The earnings of the National Carbon Company for the first quarter of the current fiscal year are said to have been at the rate of nearly 7 per cent. on the common stock. An official of the company says there is enough business in sight to assure earnings for the entire year at that rate, or even more.

Chicago Telephone stock sold at 125 in Chicago on Friday, a drop of 10 points from the last preceding quotation, about the middle of April. The company's legal trouble with the city of Chicago concerning rates and the necessity for renewing the franchise soon have told against the price of shares.

The Northern Westchester Lighting Company of Ossining, N. Y., has been incorporated to supply gas and electricity for light, heat and power purposes. The capital stock is $1,000,000, and the directors are William J. Bagnell, Louis B. Grant, James H. Hagarty, of Brooklyn; Charles T. Lark and Ashley T. Cole, of New York, and Alexander Keogh, of New Rochelle.

The First National Bank of Milwaukee, Wis., has had assigned to it about two-thirds of the capital stock of the National Electric Company as security for loans. The bank has now taken over the control of the National Company, and John I. Beggs, Charles E. Pfister, Frederick Vogel, Jr., J. H. Van Dyke, Jr., all of whom are directors of the First National Bank, have been elected directors of the National Electric Company.

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price May 6
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	202½
Manhattan Elevated Railway	164⅞
Metropolitan Street Railway	116⅝
Metropolitan Securities	77⅝
Ninth Avenue	197
Third Avenue	124
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	60⅜
Brooklyn City Railway	240
New Orleans Railway	4¼
Public Service Corporation (New Jersey)	121
Philadelphia.	
Consolidated Traction of New Jersey	83¾
Philadelphia Traction	99¾
Union Traction	61
Boston.	
Boston Elevated	158½
Massachusetts Electric Companies, com	18
do. do. do. pref.	66
West End Street, com	97½
do. do. do. pref.	116½
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	7¾
do. do. pref.	45
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	14⅜
do. pref.	54
Electric Boat, com	37
do. do. pref.	75
Electric Lead Reduction	½
Electric Vehicle, com	12½
do. do. pref.	20
Westinghouse, com	170
do. pref.	190
General Electric	174
Boston.	
Edison Electric Illuminating	250
General Electric	174
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	161
National Carbon, com	62
do. do. pref.	114
Philadelphia.	
Electric Company of America	12⅛
Electric Storage Battery, com	81
do. do. do. pref.	81
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	141¾
Western Telephone Company	18½
New England Telephone Company	138½
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210½
Mexican Telephone Company	1¾
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93⅜
Chicago Telephone Company	125
MISCELLANEOUS STOCKS.	
Otis Elevator Company	52
Consolidated Car Heating	64
Standard Underground Cable	200

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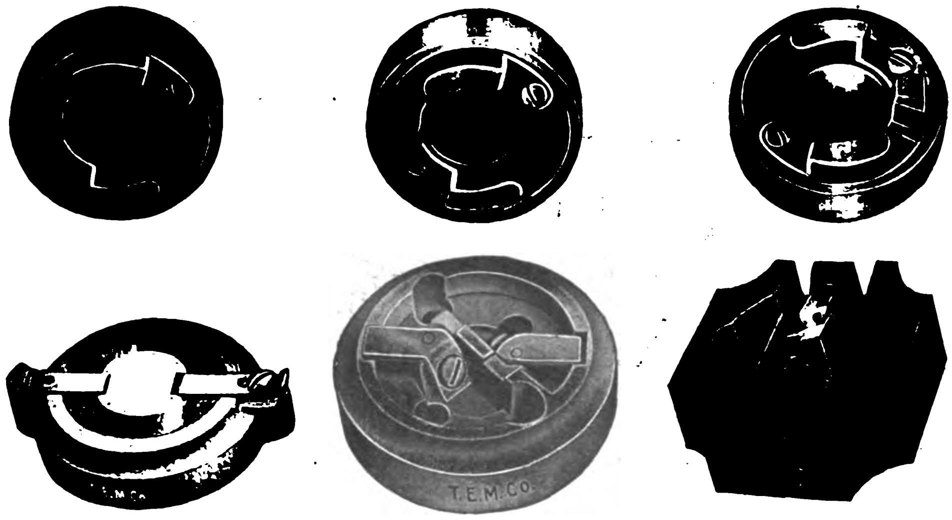

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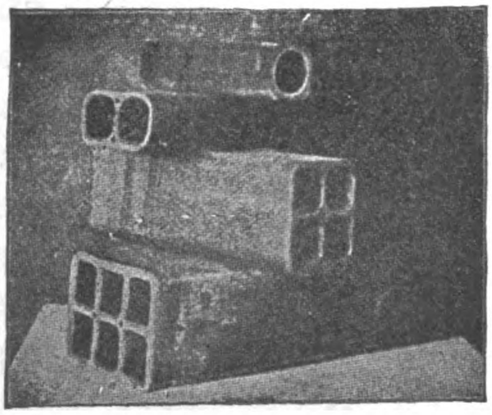

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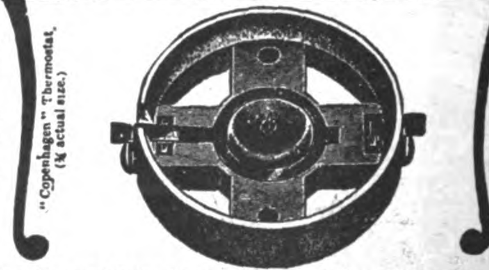

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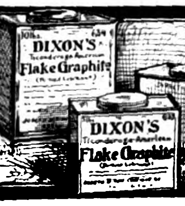

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ELECTRICITY.

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EDITORIAL NOTES.

Some Coal Statistics. In view of the enormous amount of coal annually consumed by electric lighting and power stations throughout the country, some statistics collected for the United States Geological Survey by Mr. Edward W. Parker and just made public, should prove interesting to our readers.

During 1904 the total production of coal amounted to 351,196,953 short tons, having a total value at the mines of $445,643,528. Compared with 1903 this shows a falling off of 6,159,463 short tons in quantity and of $58,080,853 in value. This decrease, although proportionately large in the figures of value, does not indicate any interruption to the generally prosperous conditions which have prevailed during the last eight years. It was simply a natural reaction from the abnormal activity which had been maintained throughout the coal-mining regions in 1903, due to the exhaustion of all coal stocks on hand by the memorable strike of 1902. In order to renew the coal stocks and at the same time to provide fuel for immediate use, the coal mines in 1903 were pushed to their utmost capacity, or, one should probably say, to the capacity of the railroads to handle the output. As a result the enormous production of 357,356,416 short tons was recorded. Prices raised high by the famine of 1902 remained high for a large part of the year and the total value of coal at the mines, before any expense of transportation or selling costs had been added, amounted to $503,724,381, an increase of $136,600,000 over that of 1902.

The production of 1904, while less than that of 1903 by 6,159,463 short tons, exhibits a normal increase when compared with the annual production during the ten preceding years. The average price for all coal mined and sold in 1904 was $1.27, as compared with $1.41 in 1903, and $1.22 in 1902.

One of the interesting features in connection with the anthracite trade is the constantly decreasing proportions of the large or more profitable sizes of coal sent to market, and the equally constant increase in the proportions of small or less profitable coal.

This in part may be attributed to the constantly growing demand for electric current. In 1890, 77 per cent. of the shipments from the anthracite regions consisted of sizes larger than pea coal and 23 per cent. represented the shipments of pea coal and smaller. In 1904 the large sizes made up only 62 per cent. of the total, while the small sizes had increased to 38 per cent.; or, putting it in another way, the total tonnage of large sizes from 1890 to 1904 has increased 25 per cent. (from 28,154,678 tons to 35,636,661 tons), while the tonnage of small sizes has increased 158 per cent. from 8,460,781 long tons in 1890 to 21,855,861 long tons in 1904.

The recovery of usable coal from the old culm banks by washing has furnished some of this increase in the shipments of small sizes and the installation of washeries at the breakers for saving the small sizes in the primary preparation of the coal has done more. The recovery from the old culm banks has averaged about 2,500,000 long tons annually during the last four years.

The statistics of bituminous coal production comprise all varieties except Pennsylvania anthracite, and include semianthracites, semibituminous, cannel, splint and block coals, and brown and black lignites. The small production of anthracite in Colorado and New Mexico is also included in the bituminous output. In 1904 the aggregate production of all these varieties amounted to 278,040,244 short tons, valued at $306,669,508, against 282,749,348 short tons worth $351,687,933 in 1903, indicating a decrease of 4,709,104 tons in amount and $45,018,425 in value. The average price a ton for all coal mined and sold, including colliery consumption, fell from $1.24 in 1903 to $1.10 in 1904.

* * *

Strikers and Autotrucks.

Even a strike is subjected to new influences nowadays. As an old sympathizer of labor says: "They are not what they were." And why not, may we ask? Chicago has just passed through a labor cataclysm in which the old feud has been renewed. It is not in criticism of the present that these few words are penned, but of the future. The introduction of new appliances in industrial life has had a remarkable effect upon the labor situation. It cannot be said that hand skill has become less, but it must be admitted that machines for taking its place have appeared in a thousand and one forms. Both crude, partially skilled and skilled labor would properly represent the classification of what is generally called labor. In the first and second case, machinery plays a most important part. In the third case, the case of skilled labor, the man is frequently indispensable. In mining, building and street railways, several millions of employes belong to the first and second category. It is from these sources that we, the general public, have best cause to know that a strike is on. A teamsters' strike, in the case of many of our large concerns today, would become a strike of autotruckists. Where there are no horses, the attack must be more or less directed against the chauffeurs. Some of our most modern autotrucks are like a wheeled bastion. It would not be surprising if in the future the more extended use of such vehicles would have the effect of modifying the violent nature of such demonstrations. It is evident that the future holds the solution of many such problems, and it is equally apparent that a pacific solution will result from the advent of innumerable types of machinery.

The wide spread of a new force like electricity for the untold industrial applications that await it will create a new attitude on the part of the worker and the employer, a feeling of co-operation and not of antagonism and a realization of the fact that the efforts of both are a contribution to our common welfare, the interruption of which can only spring from impatience or misapprehension.

The New Influence in Central Stations.

A new influence in central stations is making itself apparent. By this is meant a new type of power engine. The reciprocating steam engine has held its familiar place for half a century, but it must be admitted that the shadows of a great change are falling upon it. The steam turbine is coming to the front. The equipment called the turbo-generator is usurping the place of all other possibilities. It seems from the present outlook that the steam engine, gas engine and turbine will after a while occupy places of equal prominence in this field. But then, the turbine will win out, and for all large powers it will represent the future corner-stone of a modern central station. There are reasons for this prophesy, which judged in the light of modern progress, almost amounts to a statement of the inevitable. The natural mechanical adaptability of the turbine is in every respect calculated to inspire the beholder with a substantial estimate of its superiority in comparison with the steam engine proper. It is hardly necessary to refer to its steadiness of action, small floor space, little bulk and comparative cheapness. Its durability is of such a character that, like the dynamo, itself, it wears only at its bearings.

Such, in fact, is the new influence in central stations, which will withstand criticism and all fair tests in a demonstration of its great advantageousness.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The faculty of the Massachusetts Institute of Technology has vetoed by a vote of 57 to 5 the proposed Technology-Harvard merger.

Mr. John Gavey, C. B., engineer-in-chief of the technical department of the British postoffice service, has been elected president of the British Institution of Electrical Engineers.

The New York Edison Company will have in full operation within about 18 months an entirely new plant, located between 39th and 40th streets, on First avenue, the cost of which will be approximately $7,000,000.

Three wireless telegraph experts left Halifax, N. S., early Saturday on the steamer Lady Laurier, a Government boat, for Sable Island to select a site for a wireless station. The station at Camperdown, at the entrance of Halifax Harbor, is expected to be completed by May 24. The construction staff at work there will then proceed to Sable Island and build the second station, which it is expected will take four weeks. These two stations will work in conjunction in reporting vessels equipped with the wireless system within 200 miles of the island.

The Salem, Mass., sewerage commission has voted to adopt electric power for pumping purposes.

"Municipal ownership," says Charles T. Yerkes, "is the commencement of socialism and a reign of blackmail and corruption. The idea is all right abroad, but it will not do here."

The Canadian Electrical Association will hold its annual convention in Montreal, June 21, 22 and 23. It is expected that upwards of 200 representatives from all parts of the Dominion will be present.

The annual meeting of the stockholders of the General Electric Company was held in Schenectady last week. The following directors were elected: Gordon Abbott, Oliver Ames, C. A. Coffin, T. Jefferson Coolidge, Jr., W. M. Crane, Fred P. Fish, George P. Gardner, Eugene Griffin, T. K. Henderson, Henry L. Higginson, J. Pierpont Morgan, J. P. Ord., Robert Treat Paine, 2d., E. W. Rice, Jr., and Charles Steele. Over 280,000 shares of stock were represented by the stockholders. The directors will meet shortly and elect officers.

From an abstract appearing in the Journal of the Chemical Society of an article by Mr. V. Gabritschewski it appears, says the "Electrical Engineer," London, that if a radium preparation and any flat object are brought for a few minutes into the immediate neighborhood of an electrified ebonite plate, and the latter is dusted with a finely-divided mixture of sulphur and red lead, a sharply-outlined dust figure of the object is formed on the ebonite plate. It is not necessary that the object should be in contact with the ebonite plate, nor with the radium preparation. If the latter is placed on the opposite side of the plate, the figures make their appearance. The author attributes this to the existence of a special force which attracts the electrical charge of the plate towards the object in its vicinity.

Mr. Thomas A. Edison says he is working at present on the motor battery for automobiles. His idea is to make it possible for a tonneau car for four persons to go without recharging for 100 miles.

PORTABLE ELECTRICAL-DRIVEN HAND TOOLS.

BY RAY HAMILTON.

"Time," says Mr. Stuyvesant Fish, president of the Illinois Central Railroad, "is the essential thing, for it is the most valuable possession which most people have." This remark, though called forth in relation to the traveling public, is none the less true in every walk of life, and applies equally to the millionaire as to the artisan.

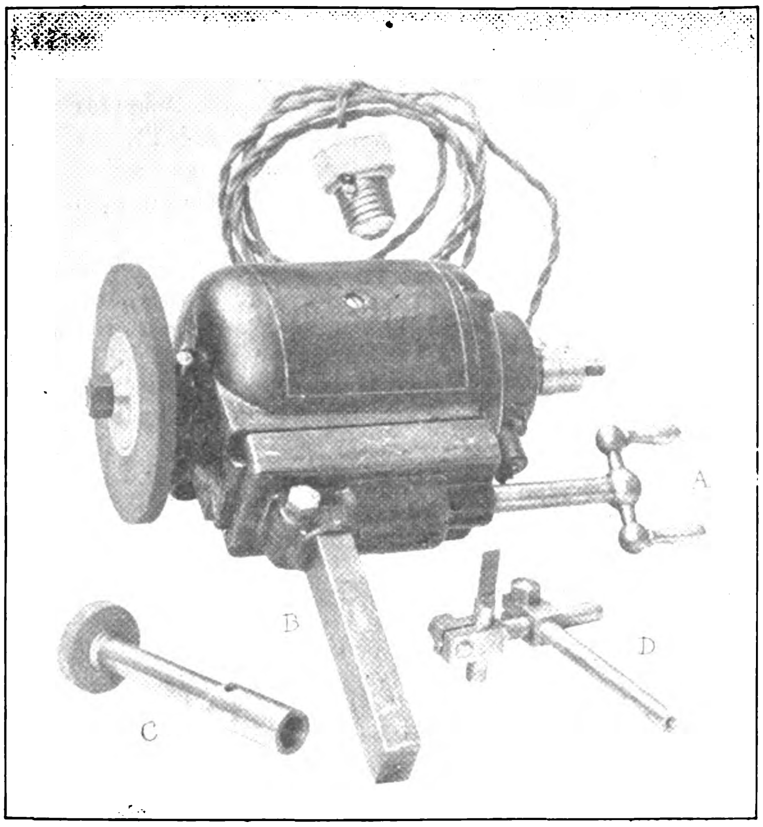


Fig. 1.—Portable Electric Grinder.

The reason machinery has replaced manual labor wherever possible, and there are indeed few places where such substitution has been found impracticable, unless it is in laying brick or milking a cow, is not alone because it does the work with more accuracy, but chiefly for the reason that it is a great saver of time, hence the old adage, "Time is money."

Time was, and not so far in the dim and distant past, since there are few still in evidence, when factories were equipped with great stretches of shafting the motion being imparted by gigantic belts connected to steam engines or water wheels and from the main line of shafting innumerable belts drove the various machines.

We do things different and better now. In an up-to-date factory a steam-electric or hydro-electric plant is installed, or, if the concern operates near a great plant, like the one at Niagara or at Shawinigan Falls, the factory is wired and each machine is connected to a separate electric motor, which is not only quicker and safer but far more economical both it its initial and running costs as against the older plan.

This progressive advance together with high-speed steel has just about revolutionized shop practice, but the end is not yet, for now portable electric tools have proven their qualities and their flexibility is one of the real marvels of the electrical designers and machine-tool-makers' arts.

The tools described and shown in the illustrations are the product of the Hisey-Wolf Machine Company, and if the reader will refer for a moment to Fig. 1, he will observe a portable electrical-driven grinder that covers a wide range of work, for it may be used for grinding centers, cutters, reamers, dies, rolls, etc., as well as for surface, parallel and internal grinding jobs of all kinds.

The shank of the grinder is clamped in the tool post of the lathe, the motor carrying on its shaft the emery wheel so that they may be set at any desired angle, in which case the wheel is moved across the face of the center to be ground by means of the handle, or the shank may be set in the tool-post of a planer, shaper or milling machine, or it can be clamped in an ordinary bench-vise. A flexible cord and attachment plug are connected and on securing the plug into any incandescent lamp socket it is ready for work.

These portable grinders are usually wound for 110 or 220 volts direct current, though in special cases they are wound from 50 to 250 volts, also for alternating current. All parts of the motor are inclosed in the shell making it dust-proof; the spindle carries taper cone bearings running in 3 degs. and 45 degs. bearings and the wear may be taken up by means of a unit on the rear end of the spindle, these being also provided with dust-proof caps. A V slide having a 3 inch travel by means of a worm through the handle A is fitted with a gib to take up the wear.

The shank B is of steel and is fitted to the hole in the V cap; it is held in position with a screw clamp so that different sized shanks can be used. The extension mandrel C is used for internal grinding by removing the regular wheel and screwing the mandrel to the spindle. A tooth rest D is a valuable attachment, serving as an index for grinding cutters, reamers, etc.; this detachable tooth-rest insures that each tooth of the cutter will be ground correctly.

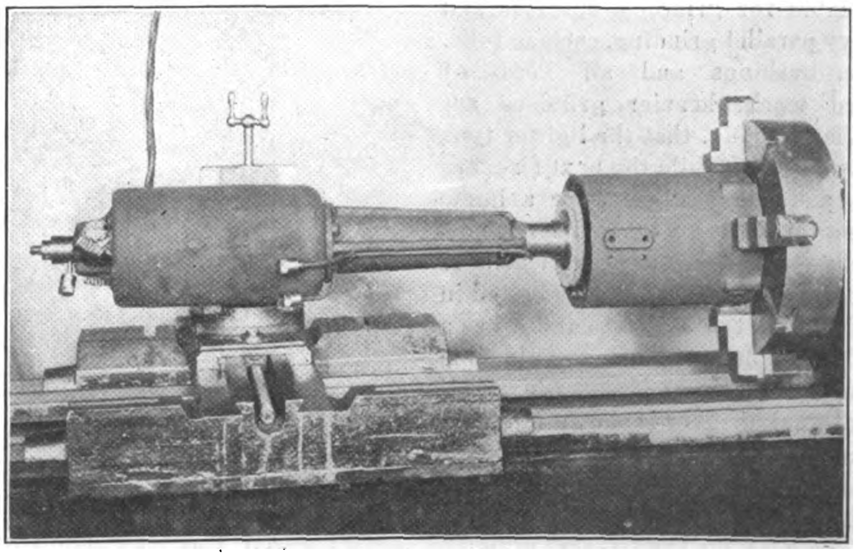


Fig. 2.—Portable Internal Grinder.

Where the grinder is set in a lathe for internal grinding the larger wheel is taken off and the extension mandrel is screwed to the spindle in its place; the mandrel C will grind a hole from ⅜ to 1½ inches in diameter. The grinder may be set in a milling machine and the cutter ground without removing it and the tooth-rest for indexing may be used as previously indicated.

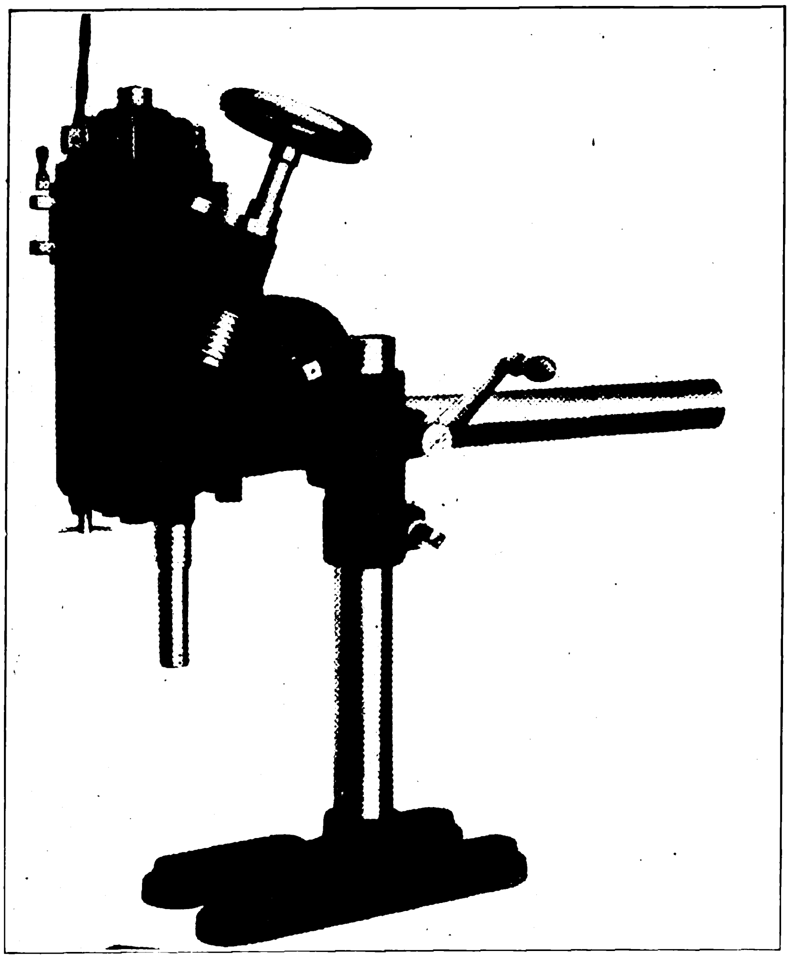


Fig. 3.—Portable Electrical Radial Drill.

Attached to the tool-post of a planer it is invaluable for grinding surfaces and for heavy parallel grinding, such as rolls, journals, bushings and all kinds of hardened work; heavier grinders are made, that is to say, that the lighter type operates on ¼ hp. while the next size has a ½ hp. and the heaviest type a horse power motor, while a 2 hp. grinder is now being constructed. In the heavier grinder the base of the angle plate is bolted in the tool-post rest of the lathe and it has a vertical adjustment to bring it in line with the centers.

An internal grinder is shown in Fig. 2 and has been especially designed for grinding and finishing up gas, steam and air cylinders, grinding out hardened dies, turning up bearings and internal cylindrical grinding of any kind. This type of machine is of the same general design as the heavier grinder, for like the latter it is bolted to the tool-post rest of the lathe. The makers furnish it for grinding to a depth of 20 inches where necessary. The minimum size hole this machine will grind is ½ inch and the maximum, 4½ inches.

Another development of these portable machine tools is a motor equipped with a flexible shape, the latter being fitted with a chuck for holding small drills or a mandrel with emery wheel for drilling, grinding and other purposes. It is pointed out that this machine is particularly adapted for pinholes or light drilling of any kind, also for grinding dies, scroll and ornamental work, while it can also be used for light buffing, polishing or sanding.

Still another handy tool of this type is the electrical aerial surface grinder; this is arranged so that it can be suspended anywhere by means of a strong spiral spring or counter balanced from the ceiling or a traveler. This machine was especially devised for rough surface grinding and the cleaning of castings and for such purposes it will be found an efficient substitute for hand filing and chipping. It is fitted with stationary end handles on an adjustable spade body handle, depending upon the class of work to be done.

A portable, electrical radial drill, shown in Fig. 3 is designed on new and original lines and is especially suitable for light work; it is virtually a universal radial drill in that it will do practically all the work of a stationary radial drill throughout the range of its capacity, and being portable it can be taken to the work instead of bringing the work to it.

The drill is provided with a 10-inch feed through the hand wheel with a quick return by hand. It has a radius of 24 inches in any direction at any angle; both the hand wheel and worm box have swivel adjustments from horizontal to vertical, thus permitting the use of the drill in corners and close places according to where the work is to be done. The spindle is fitted with a ball-bearing thrust and carries a taper socket; the drill has two speeds, changeable by means of a thumb lever at the lower end of the motor. The vertical and horizontal columns are made of hollow steel tubing and are adjustable, enabling the operator to drill at any angle and in any direction.

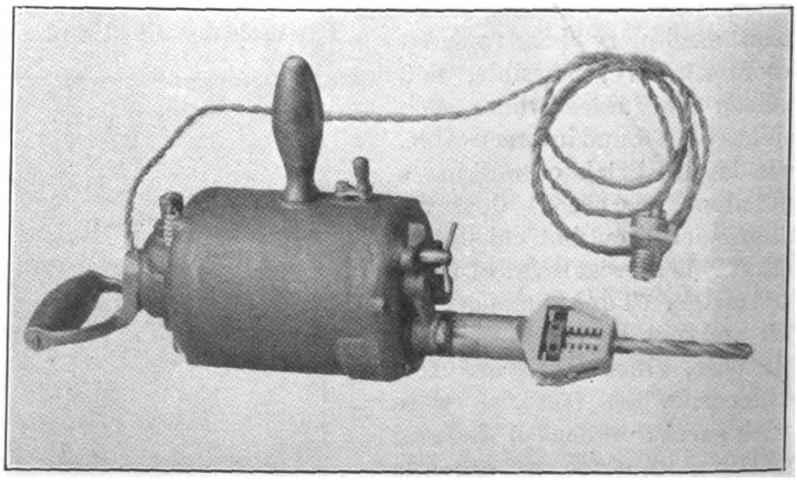


Fig. 4.—Electrical Hand Drill.

The labor-saving hand and breast drill is shown in Fig. 4, and is useful for drilling holes in wood or metal. It is designed to be used wherever the old style hand drill can be used, and not only does it save the strength of the operator, but it works many times quicker for it is driven continuously and at a much higher speed.

The motor is provided with a switch to start and stop it, so that it is under absolute control at all times, and as the switch is located near the vertical handle it is easily reached by the index finger. The chuck spindle is so arranged as to allow drilling on a line with the base of a motor and by this arrangement angle and corner drilling are permitted. The motor, which is inclosed, is suitably geared to develop the necessary power up to the capacity of the drill.

These drills may be equipped with a breast plate and side handles and used as an ordinary breast drill if desired. The drill shown in Fig. 4 has two speeds, operated by means of the lever on the front end of the motor, and with this useful device a slow speed for large drills may be used or a faster speed for smaller ones. These electrically-driven tools are built to withstand the rough usage to which this class of appliances is subjected and they are without doubt the most powerful and compact tools ever built when their extremely light weight is considered.

LIGHTING AN ASSEMBLY ROOM.

ARTICLE I.

BY W. H. WAKEMAN.

The following description of the plan adopted for controlling lights in the assembly room of a large school building is given as a matter of practical interest, because it works well, therefore may be suggestive to those having such rooms in charge at other places and prove beneficial for any hall of medium size where something more than a single switch for turning lights on and off is wanted.

A plan for doing this gradually is superior to one which makes the change all at once for two reasons, as follows:

When it is desired to relight a room that has been darkened, if the lights appear gradually the effect is pleasing, whereas a sudden change from darkness to bright light is neither pleasant nor profitable.

It is better for the machinery to make these changes slowly, especially if the load consists of lights and motors on the same generator. If lamps in other rooms are supplied from the same source, they will be affected by any sudden change, provided the assembly room lights form any considerable percentage of the whole load.

To illustrate this, suppose that while supplying current for lights and motors, requiring, say, one-half of the power of engine, all lights in an assembly room are put on at once.

Now the effect of throwing more load on a compound wound dynamo is to raise the voltage, provided the extra load is not enough to materially reduce the speed of the engine. If it is enough to make the engine run slower, which in turn reduces the travel of armature, the voltage is made less, consequently the motors may be turned into generators owing to their momentum, thus reversing the polarity of dynamo and stopping the motors. All lights will go out leaving the rooms in darkness, but so far as incandescent lamps are concerned the dynamo may be started again without delay and the lamps turned on.

It will probably be necessary to throw in the circuit breaker or renew a fuse before this can be done, and connections on both voltmeter and ammeter must be changed in order to secure correct indications of pressure between the lines and the rate at which current flows over them, but this can be done in a few minutes.

Fig. 1 shows these instruments before the reversal of polarity, and Fig. 2 illustrates the changed connections.

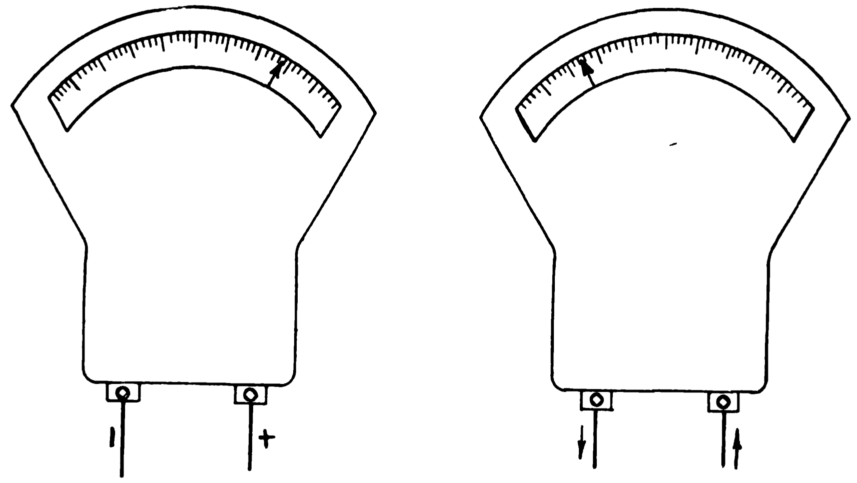


Fig. 1.

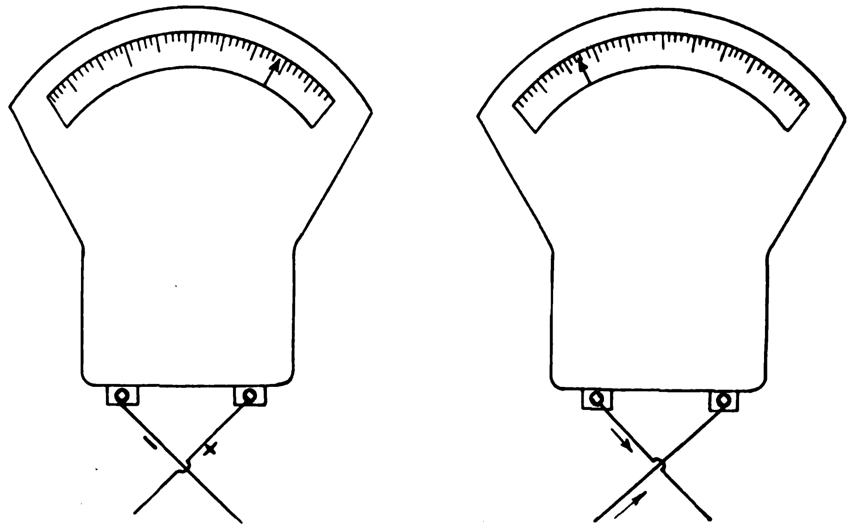


Fig. 2.

Care should always be taken to avoid putting out lights suddenly where people are assembled, as it may cause a panic in which many will be injured.

There are two ways for turning on lights gradually, one of which is to provide a rheostat or resistance box, by means of which the amount of current passing to lamps may be controlled, thus causing them to glow at first and burn brighter later on. The objection to this plan is that it is not practical to continue it for a long time, as every lamp on a given circuit is supposed to be adapted to the voltage carried, therefore if burned at any other it does them no good, to say the least, and sometimes it results in positive injury, depending on conditions.

The better plan is to wire the room so that lamps will be on several circuits, making it convenient to turn on a part of them at full voltage.

In the case which forms the subject of this article, a junction box which is also a fuse box and switchboard, is located near this assembly room where it cannot be seen by the audience, but is convenient to the comparatively large stage provided.

This is fitted for the three-wire system, but as only two wires are used to supply current from the main switchboard, the two outside lines in the fuse box are made positive, leaving the central negative.

Fig. 3 illustrates the ceiling of this room as it appears from the floor. There are four chandeliers each containing six groups of three lamps each, and six lamps arranged about a central fixture, or 24 lamps to each chandelier.

When one switch is thrown in, it lights one-half of the lamps in two chandeliers, or 24 in all. It includes three groups on each, taking each alternate group of three and every other lamp in the central group. Another switch controls one-half of the lamps in the two other chandeliers, arranged in the same way.

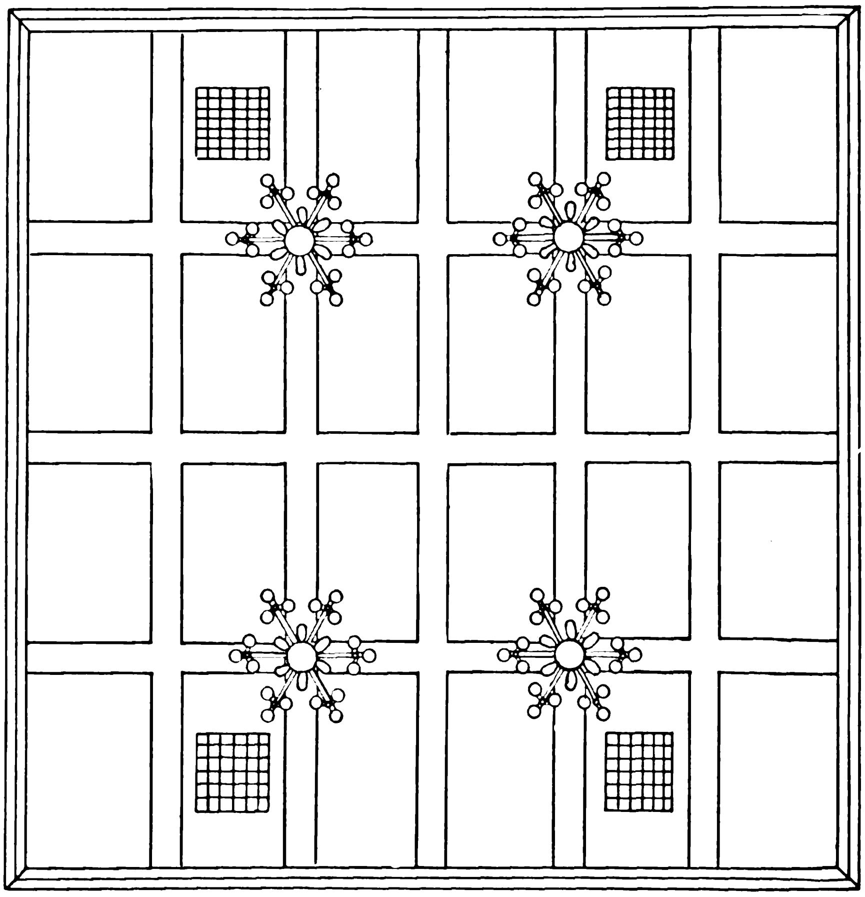


Fig. 3.

When these lamps are viewed from the floor they appear in symmetrical form, as if no more were available, and a soft light is evenly distributed throughout the room. When more is wanted two more switches are thrown in, causing all lamps to be lighted and giving the appearance shown in Fig. 3.

Whatever heat is generated by these lamps assists in ventilating the room, as it warms all air which passes out of four ventilators shown, thus causing the flues to act as chimneys.

Automatic Telephone Exchange in Vienna.

Since April 1 a 200-line automatic exchange on the Strowger system has been experimentally in use at the Berggasse telephone exchange in Vienna. According to the "Elektrotechnische Zeitschrift," provision has been made for an ultimate extension to 10,000 subscribers, if the first experiment is successful.

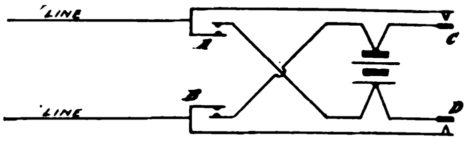
ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

TELEGRAPHY BY WIRES.

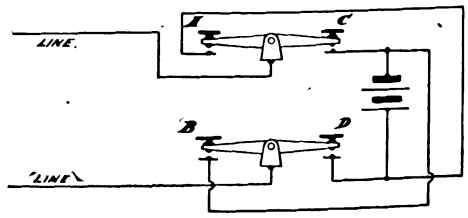
Signaling by means of electricity was attempted many years before Morse was born. It was necessary for the invention of the electromagnet by Joseph Henry to be made before such efforts could be attended with success. In all, three distinct contributors to the invention of the telegraphic system appear—first, Daniell with his constant closed circuit battery; second, Joseph Henry with his electromagnet, and, third, Morse with his crystallized invention. The Daniell cell became modified into the well-known form of the gravity battery in almost universal use in the United States for telegraphic purposes for over 40 years. The electromagnet was applied to telegraphic purposes by Morse, by means of an armature, an arm extending from it and a stylus or marking device attached to this arm which made impressions upon a piece of paper tape, passing beneath it.

The Two Systems.—Examination discloses the obvious fact that two systems of telegraphy exist. They are called the open-circuit and closed-circuit systems. The original Wheatstone or needle system is operated in such a manner that the needle, surrounded by a coil of wire, is deflected either to the right or left by means of a tapper or telegraphic key, which closes the circuit in either one direction or another. It is in fact, a reversing key, through which the needle swings as desired. It possesses two levers, the action of each when pressed controlling a particular direction of the current.

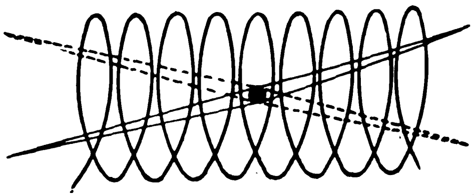


Current reversed in line, when A and B are joined to line or C and D to line.

In one case the key when pressed sends a current out over the line to the distant station. This is called a positive current because it issues from the station through the line returning through the earth connection. The other key when depressed sends the current into the earth to the distant station from which it returns by means of the line; it is therefore called a negative current. The single needle Wheatstone telegraph instrument consists of a coil arranged in a vertical position, operating a vertically poised needle which is connected to a larger dial needle. The movement or combination of movements of this needle to the right and left constitute a series of characters to the telegrapher which are readily understood and represent the code employed. When the needle is affected by positive and negative currents respectively the circuit is being closed by either one key or the other. The system is therefore one in which the circuit remains open when not in use, in complete contradistinction to the Morse system, which always remains on closed circuit except when in use.



Principle of reversing keys shown for sending positive or negative currents in the line.



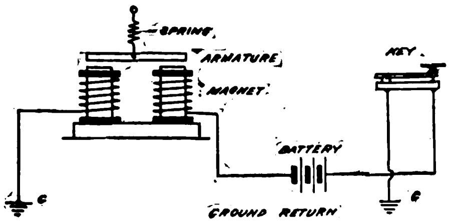
The two positions assumed by needle when the current is reversed in the coil.

The Morse Closed-circuit System.—According to the data supplied by authorities on the history of telegraphy, such as Prescott, Culley or Preece, Lesage of Geneva as far back as 1774 exhibited a system of telegraphy. This, however, was electrostatic in character and therefore impractical. The information on this point, however, is interesting and presents itself in the following form:

Inventor.	Character of the invention attempted.	Date.
Lesage	Electrostatic signals	1774
Lomond	“ “	1787
Cavallo	“ “	1795
Ronalds	“ “	1816
Soemmering	Electrochemical “	1808
Ampere	Electromagnetic “	1821
Henry	“ “	1831
Schilling	“ “	1833
Weber	“ “	1833
Cooke	“ “	1837
Wheatstone	“ “	1837
Morse	“ “	1837
Steinheil	Used earth as return	1837
Gintl	Duplex system	1853
Stearns	“ “	1870
Stark	Diplex “	1855
Bosscha	“ “	1855
Heaviside	Quadruplex “	1873
Edison	“ “	1873
Varley	Harmonic “	1870
Gray	“ “	1874

Then follows, in addition to these inventors, the work done in the printing telegraph by Hughes, the efforts of Cowper in 1876 and of Elisha Gray in 1893 to perfect an automatic system of telegraphy. In conjunction with this epoch making series of investigations and experiments the cable came into existence through the efforts of Lord Kelvin who invented the mirror galvanometer and the famous and unreplaceable siphon recorder. This mass of inventive work has left a permanent impression in the form of the English or European needle telegraph, the cable system for transatlantic signaling, the Morse or sounder system, the printing telegraph used in the well-known ticker and the telautograph of Gray, by means of which handwriting is transmitted with all the speed of telegraphic signaling. Among all these, the Morse sounder system, a development from a tape system formerly employed, calls for consideration. It is, as stated, a closed circuit system in which the current is always circulating through the line and instruments. Signaling is done by means of a telegraph key, which simply opens the circuit instead of closing it, as in the Wheatstone system. When thus opened a sounder is thrown into operation and gives a loud click.

The Sounder.—The sounder consists of a pair of vertically mounted electromagnets which attract an armature against the tension of a spring. The action of the key either releases or attracts this armature, the sound of which, as related to the intervals between the sounds, represents the equivalent of the telegraphic code invented by Morse. The original code was used in conjunction with tape in which a cut or mark was made consisting of dots and dashes.



Elements of a closed circuit system, including sounder, key, battery and earth connection.

The Morse code is called by the two names of International code and the American code. The latter is employed in the United States and Canada. The International code is given as follows:

A	. –	J	. – – –	S	. . .
B	– . . .	K	– . –	T	–
C	– . – .	L	. – . .	U	. . –
D	– . .	M	– –	V	. . . –
E	.	N	– .	W	. – –
F	. . – .	O	– – –	X	– . . –
G	– – .	P	. – – .	Y	– . – –
H	. . . .	Q	– – . –	Z	– – . .
I	. .	R	. – .		

The American Morse code differs in certain respects and is given in the following with numbers. The difference is in the spacing between the dots and in the use of more than four signals to represent some characters. In Y for instance, the spacing between the four dots is important as in Z. On the other hand P is made up of five dots, etc. The numbers also disclose the use of more than four signals in some instances, although no such precaution in spacing is necessary as in the alphabet itself. The various typographical signs are added to make the illustration more complete.

The American Morse is as follows:

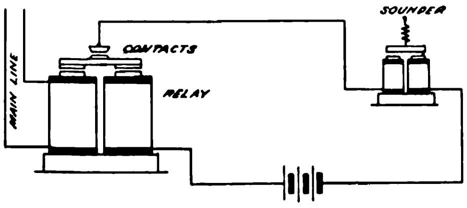
A	. –	M	– –	Y	. . . .
B	– . . .	N	– .	Z	. . . .
C	. . .	O	. .	1	. – – .
D	– . .	P	. . . . .	2	. . – . .
E	.	Q	. . – .	3	. . . – .
F	. – .	R	. . .	4	. . . . –
G	– – .	S	. . .	5	– – –
H	. . . .	T	–	6	. . . . . .
I	. .	U	. . –	7	– – . .
J	– . – .	V	. . . –	8	– . . . .
K	– . –	W	. – –	9	– . . –
L	–	X	. – . .	0	——

Punctuation marks:

Period	. . – – . .
Comma	. – . –
Semicolon	. . . . .
Colon	– . – . .
Exclamation	– – – .
Quotation marks	. . – . – .
Parenthesis	. . . . . – .
Interrogation	– . . – .
Paragraph	– – – –
Dollar mark	. . . . – . .

The American system of telegraphy is spreading all over the civilized world to the exclusion of other systems. The French, Germans and English are adopting it almost entirely at their principal telegraphic centers. It is only a question of a few more years and other methods of telegraphic communication will have become obsolete.

Purpose of the Relay.—Although the chief constituents of a simple telegraph system, consist of a sounder, battery, key and line, another important adjunct, became necessary in the shape of a relay. A relay is a device employed for the purpose of receiving the incoming signal, throwing into action a new set of batteries, and with these new cells reproducing the signal with greater emphasis. It is evident that its usefulness is dependent upon the condition of the line. If such leakage occurs, that the current becomes too weak to produce an effective signal, either due to the length of the line or the poorness of its insulation, then it is necessary to interpose an instrument which is sensitive to delicate currents. A relay is of this character, in that it consists of an electromagnet which attracts an armature over a distance not greater than the thickness of a sheet of paper with a very weak current.



Elements of a local circuit, showing relay, its contacts and sounder in circuit.

When the armature is attracted it closes a new local circuit in which is a sounder. Therefore, every time the relay operates, and its contacts meet, the sounder and its operating cells are thrown into action. A station therefore contains the main line, and in addition its own local circuit by means of which it is able to reinforce the current. In telegraph stations there is found

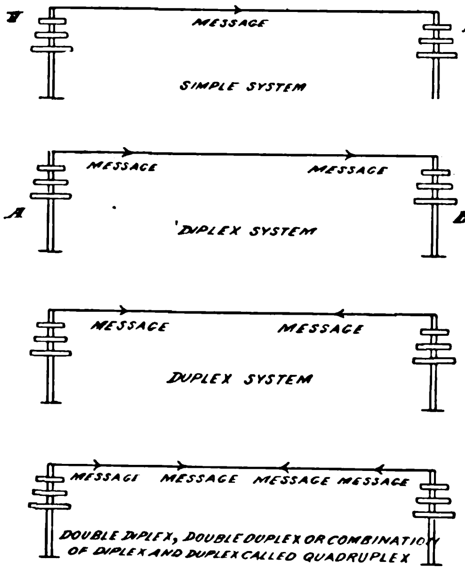
First—The main circuit.

Second—The local circuit.

A sounder has two binding posts which connect direct to the battery via the relay. The relay possesses four binding posts; two of which connect with the incoming line, and two of which complete the circuit of the sounder and its battery.

The sounder, relay and key are generally mounted on one board for convenience. The relay is really a very high resistance sounder with a very limited action, no sound, but a pair of platinum contacts connecting to the local circuit. If a sounder takes $\frac{1}{4}$ or $\frac{1}{10}$ of an ampere to operate, the relay will take about $\frac{1}{10}$ of this. The relay current is so small that it cannot be measured in an ordinary manner. It is estimated in one-thousandths of an ampere, milliamperes as they are called. A relay takes about 10 milliamperes if well adjusted, and sometimes less.

Messages Over One Wire.—The messages that may be sent over one wire at the same time depend upon the character of the apparatus at the ends of the line. The following shows the extent to which the telegraphic system has developed at the present time:


A
MESSAGE
B
SIMPLE SYSTEM
MESSAGE
MESSAGE
A
DIPLEX SYSTEM
B
MESSAGE
MESSAGE
DUPLEX SYSTEM
MESSAGE MESSAGE MESSAGE MESSAGE
DOUBLE DIPLEX, DOUBLE DUPLEX OR COMBINATION OF DIPLEX AND DUPLEX CALLED QUADRUPLEX

The analysis of the telegraphic systems in common use.

From either end—One message over the line at once—The simple system.

From one end—Two messages over the line at once—The diplex system.

From both ends—One message over the line at once—The duplex system.

From both ends—Two messages over the line at once—The quadruplex system.

From both ends—Four messages at once—The multiplex system.

From both ends—Any number of messages at once—The Delany system.

In explanation of the above it may be stated, that the simple system is merely a case of transmitting a signal, *one at a time*, over the wire, which of course is returned by way of the ground connection.

A Diplex System is one by means of which two distinct signals may be sent at the same time *from one end* of the wire without confliction and be received at the other end without trouble. These signals or messages both travel in the same direction, thus making the simple system and diplexing a line related to each other. One being only one message in one direction, the other being two messages in the same direction simultaneously.

A Duplex System permits a message to be sent from each end of the line at the same instant without confusion. It differs from the diplex as regards the direction of the messages. The diplex sends both one way, the duplex both in opposite directions at the same time.

A Quadruplex System is one in which two messages may be sent from each end of the line at the same instant, making four in all, two moving in one direction, and two in the opposite direction. This system might be called either a double diplex, a double duplex, or a combination of a diplex and duplex system. The latter idea is carried out in practice, that of using devices by which the line is diplexed and duplexed for the purpose of conveying four messages at one time.

A Multiplex System.—This idea can be carried out beyond this point, in fact to such an extent that eight messages may be transmitted simultaneously, in which case, octuple name given to the system. But a development of this order would naturally call for the use of a more and more complicated system of devices beyond the reach of human intelligence to manipulate successfully. Patrick B. Delany invented a system in which complications of this order are avoided. But a new set of difficulties appear in the invention entitled the Delany Synchronous System of Multiple Telegraphy. The difficulty, which it is claimed, has been overcome, is one from which the system derives its name. It is that of keeping in synchronism a set of levers which must rotate in perfect accord with each other, even in so far as a part of a revolution is concerned. They are situated one at each end of the line, and in their rapid rotations touch exactly the same points at the same instant on a pair of corresponding dials over which they swing. The arms themselves are connected to the line, and the dials to the various branch stations in the near radius. As the arms rotate, they touch successively contacts arranged around on the dials, the same contacts at the same instant. By this means before the telegrapher can lift his hand from the key, the arm has touched the contact connecting to his station and the signal has reached its destination through the distant arm touching a corresponding contact.

ELECTRICAL REPAIRS AT SEA.*

The applications of electricity in the navy are so many and varied in their nature, and the conditions under which repairs and the accompanying tests have to be carried out often so adverse, that in many cases ordinary shore-going methods are in a great measure inapplicable. Consequently it is very often that makeshifts have to be resorted to and rough tests applied, which would appear strange to those who are accustomed to work in the ordinary lines of everyday life.

To begin with, a man-of-war carries a certain fixed proportion of stores, instruments and spare gear, based upon the average demands as they have been represented in time past, and anything that is required outside these limits must be supplied by the ingenuity, craftiness or liberality of the torpedo lieutenant in charge of the ship's installation.

Owing to the use of electricity in the big guns and explosives generally, it is essential that there should be no possibility of tests being carried out with instruments capable of giving sufficient current, under any circumstances, to bring in an element of danger.

The two principal instruments which are supplied for all ordinary testing use the form of gravity Daniell cell known as the Minotto sawdust battery.

These instruments have been described in former articles in detail, and it will be sufficient here to remind our readers that one known as the single-cell test battery consists of a low-resistance detector mounted on a single cell, while the other consists of six smaller cells in a box with a high resistance astatic detector joined up so that any number of cells from one to six can be put in circuit by shifting a plug.

As a matter of fact, these detectors are both known in the navy as galvanometers, and are distinguished by their approximate resistances, which are respectively 20 and 1,000 ohms, but they can hardly be regarded as measuring instruments as they are not calibrated and the magnetic saturation of the needles is liable to vary considerably. The single-cell instrument is used for detecting continuity in a circuit by giving a pronounced swing, and is capable of showing as low a conductance as 1,000 ohms, roughly speaking, the deflection then being only just distinctly perceptible; the cell has an average internal resistance of 50 ohms, which with the detector in circuit is brought up to 70 ohms, and therefore it can never give a greater current than about one-seventieth of an ampere, or less than one-hundredth of that required to fire the ordinary naval fuse used for explosions. The six-cell battery is used for detecting faults in insulation and may be relied on to discover faults of the order of 40,000 ohms. With this instrument, which is used for all ordinary tests, the operator is satisfied if he can detect no movement of the needle when the key is pressed.

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*Abstract of a communication to the "Electrical Review," London.

Both instruments are in a very portable and convenient form, and are capable of standing a great deal of rough handling. Their utility, however, does not end here for a great deal of measuring and comparison work can be done with each of them.

Every ship carries a large number of cells of the Leclanche type for gun circuits, bells, telephones and all manner of open circuit work, and it is necessary to test these cells continually to see that they are in good working order, and capable of giving the full current required. The test that is laid down for these cells is based upon their capability of fusing a certain length of platinum-silver wire, equal to that in an ordinary gun fuse, through a specified resistance.

The process of testing in this way with the instrument supplied for the purpose is exceedingly tedious in practice, and the torpedo lieutenant has other things to do besides spending the best part of his life testing batteries; consequently he is often tempted to make a short cut with that invaluable instrument, the single-cell test battery.

The methods employed must be somewhat as follows: A cell is chosen which is expected to be in good condition, and the service test is carefully carried out with it by fusing platinum-silver wire.

If it gives a satisfactory test it is put aside while the detector of the test battery is shunted by a moderate length of low-resistance wire; the Daniell cell of the instrument will not be used and is disconnected. The shunt wire is now adjusted by trial until the detector gives a convenient deflection, when the particular cell under test is joined to its terminals and the deflection is noted. Now it is obvious that any other cell which will give the same deflection when momentarily joined up to the detector is in as good condition as the cell first tested. The arrangement can very easily be carried about and the test applied to all the cells in the ship. Those which are at all doubtful can be removed and tested in detail at leisure.

Another use to which the single-cell test battery may be put, and which is useful in measuring voltage, is as a standard in conjunction with an improvised potentiometer. In this case the cell is taken as giving 1.04 volts, and moderate voltages can be compared on an ordinary black-lead pencil split in two, with divisions marked off on the wood in which the carbon lies. Care, of course, must be taken to see that the lead is not broken.

The way in which such a potentiometer is made is as follows:

A really good drawing pencil is taken and soaked in water; the glue is thus softened, and the half which has not got the plumbago embedded in it comes away fairly easily.

The remainder of the pencil is now carefully dried; a couple of notches cut close to either end are then made in the wood and a binding of copper wire wound into them so as to make good contact with the plumbago. The ends of these copper bindings can either be used as leads themselves, or have flexible leads soldered to them. The slider consists of a piece of similar wire taken once round the pencil and twisted to its own part rather tightly, so as to make a fair contact with the core of the pencil.

The arrangement is now tested by marking a half-way point and putting the slider on to it.

Two test cells from the test battery are connected to the ends, and the slider with the sensitive detector and a single cell joined in series connected to one of the ends so as to reduce the difference of potential; if the instrument is properly constructed the galvanometer needle will not be deflected. The slider is then moved until a perceptible deflection is noted, which shows the minimum scale that may be used. The wood surface is now divided off into a suitable scale, and the potentiometer is constructed.

This little device, it must be remembered, can be carried about in the pocket and applied in all sorts of holes and corners, and herein lies its virtue; the six-cell test battery, taking the difference of potential of each cell as 1.07, gives with all the cells in series 6.42 volts, while the voltage most common on board ship is from 80 to 100, hence no very material error need be expected even in testing the lighting mains, and where batteries for the firing circuits are suspected of giving a low voltage, the results are proportionately accurate.

The batteries are used in sets of three, six or ten cells, according to the kind of gun they are used for, and therefore in order to quickly test all the batteries on he upper deck after, say, a night attack by torpedo boats, when in consequence of sustained firing a considerable strain has been put on them, and another attack is expected shortly, it is easy to apply the potentiometer to the terminals of each in turn without disconnecting anything and detect at once any that seem likely to run down. The slider being set once for this type of battery need not be shifted, the deflection of the galvanometer showing at once if they are above or below the standard fixed by its deflection either way.

There is another method of calibration which is far more simple and proportionately rough; it consists in joining the searchlight resistances all in series. Each of these has a resistance of .2 ohm and can carry 100 amperes of current with safety, consequently four of these can be put across the dynamo terminals and there will be 20 volts fall each. Presuming that the pilot lamp will show approximately if the dynamo is giving its correct 80 volts, three other readings may be obtained. Ammeters can always be checked if one's voltmeter and Wheatstone bridge are in order and besides they do not intrude themselves upon the torpedo lieutenant's notice to the same extent as the voltmeter, for it must be remembered that the lights in the captain's cabin are among the most distant from the dynamo and that captains are very liable to be very low reading voltmeters on their own account and are not inclined to enter into lengthy arguments where their eyesight is at stake.

By all means let the meter in the dynamo room read only 80 volts, but at the same time let it not be at variance with the captain's judgment; he is not likely to go pottering about down below for the purpose of proving himself in the wrong, and if Mahomet will not come to the mountain there is only one course open to the market if peace is to reign among the torpedo staff.

PROPOSED NEW SUBWAY FOR NEW YORK.

Routes for new four-track subways extending the entire length of Manhattan Island on both the east and west sides, involving an expenditure of $125,000,000, were laid out formally by the Rapid Transit Commission last Friday, and will be acted upon by the Board of Aldermen.

The mayor declared that every effort would be made to have the routes approved before the bills were signed in order that the determination of the aldermen to test the constitutionality of the laws would not delay the construction of these subways.

The lines approved were for Lexington, Third and Seventh and Eighth avenues. This week the commission expects to approve of the 34th street, crosstown and the Brooklyn routes, the week following the lines laid out for the Bronx, and a week later the bridge loop, the First and Ninth avenues, and the Grand, 14th, 23d and 59th street cross-town lines.

As adopted the routes cannot be changed by either the Board of Aldermen or by the Board of Estimate, should the routes be referred to it under the new laws. The municipal authorities must accept the lines laid down by the commission as a whole or reject them entirely. The final plans provide for three subways through Herald Square, one four-tracked line through 34th street from the East River to the North River and two two-tracked lines, one through 35th and the other through 36th street, from Third avenue to Eighth avenue.

Mr. Rice, the acting chief engineer to the commission, stated that trains would be running to Battery Park over the Broadway section of the Brooklyn extension in about six weeks. He notified the commission also that the tunnel under the Harlem River was completed and had been turned over to Mr. Belmont's company by the sub-contractor. He added that trains would be running into the Bronx under the Harlem River in about six weeks.

Boston Edison Company Pushing Refrigerating Apparatus.

The Edison Electric Illuminating Company of Boston has recently exploited the sale of electrically driven refrigerating machines run upon the ammonia compression system, and particularly adapted to the requirements of cold storage in meat markets, creameries, dairies, drug stores, restaurants and hotels. The operation of the motor is automatically controlled by a thermostat in the refrigerating box; the feed of ammonia is automatically regulated by the pressure in the expansion coils, and the supply of cooling water is determined automatically by the condenser pressure. The development of these automatic devices has been the only obstacle which has heretofore prevented central stations from taking up and pushing mechanical refrigeration.

During a recent test of nearly 600 hours, a motor driven refrigerating machine was stopped automatically more than 1,500 times at the predetermined temperature of 36 degs. Fah., and started again when the temperature had risen to 38 degs., thus absolutely maintaining the inside temperature within a 2 degs. limit. Such a performance as this indicates a large saving over the cost of ice, and greater cleanliness and convenience of operation is also secured. In a heat insulated space of 4,000 cubic feet ice will maintain a minimum temperature of 45 degs. in hot weather, and will cool about 4,300 pounds of food supplies in 24 hours. Equivalent automatic mechanical refrigeration in the same space and under like conditions will easily produce 45 degs., or the usually desired cold storage temperature of 36 degs. in the smaller space of 2,300 cubic feet, and will cool about 4,600 pounds of food supplies per day.

Big Independent Telephone Company Incorporated.

The Great Eastern Telephone Company, capitalized at $30,000,000, has been incorporated in South Dakota. The company purposes operating a general telephone system, with messenger service. Its principal office is to be in Huron, S. D., and it will have a branch office in New York City.

The new corporation is in some manner connected with the State Line Telephone Company, the Atlantic Telephone Company and the New York and Eastern Telephone Company of New York City. It has been incorporated largely by the same interests.

The incorporators are Loyal Ward Reynolds, Stephen M. Conger, Eugene H. Brock, Henry N. McCay, John I. Wheaton, Edward Neuman and Elias J. Beach, of New York City, and Philip Lawrence, M. H. Lawrence, Marion Hoke and L. S. Robbins, of Huron, S. D.

This incorporation represents an important step in the extension of the Independent Telephone interests of New York and neighboring States, and there are grounds for believing that an Independent service will shortly be offered in what is called the "metropolitan district," including New York City and its thickly settled environs. The project has been laid before several important banking houses in the financial district. It is declared that the activity of the Independents in this direction is the real cause of the recent successive reductions in the scale of prices charged by the Bell Companies.

The General Electric Company sends out the statement that it is now employing 18,500 men in its Schenectady plant —the largest force it has ever employed.

End of the Railway Congress.

After one of the most interesting as well as successful meetings in its history, the International Railway Congress formally closed its sessions in Washington, D. C., on Saturday, and the delegates are now on their tour of inspection of the various railways of the country before leaving for their homes. Among the important official conclusions reached by the Congress, probably the most timely, is the resolution passed regarding rates, as follows:

"Tariffs should be based on commercial principles, taking into account the special conditions which bear upon the commercial value of the services rendered. With the reservation that rates shall be charged without arbitrary discrimination to all shippers alike under like conditions, the making of rates should, as far as possible, have all the elasticity necessary to permit the development of the traffic, and to produce the greatest results to the public, and to the railroads themselves."

Concerning automatic signaling devices, the Congress concluded, "That automatic signaling properly designed and installed, be recognized as a suitable means of protecting trains and switching movements. The Congress notes there has been much improvement and extension in automatic signaling since the last Congress, and that those who have used it have found it effective for their purposes. The Congress is not prepared to recommend automatic signaling for general installation to supersede existing systems, but it considers there are cases where this system may present general advantages."

Full of Instructive Matter.

Electricity Newspaper Company:

Gentlemen: Your sample copy of Electricity came to hand some time since. I have perused same very carefully and am sending you check for one year's subscription, as I do not know of any similar journal so full of instructive matter and splendid suggestions.

Your favor of April 29 in reference to Electricity has been preserved on my desk, and having again come to light this morning has served to remind me of my tardiness in sending in my subscription. I shall be glad to receive the next issue. I thank you for the sample copy and trust the coming numbers may afford as great interest.

With best wishes for your success, I am

Very respectfully,

O. H. Caldwell.

Ohio street and Capitol avenue, Indianapolis, Ind., May 8, 1905.

New York-Denver Special Train.

Arrangements have been completed for a special train of Pullman sleeping, dining, parlor, smoker and observation cars, via Pennsylvania and Burlington Railways, leaving New York at 10:25 A.M. Saturday, June 3, and running as the second section of the Limited, for the National Electric Light Association Convention. The train will arrive at Chicago at 8:25 A.M. June 4, leave at 11:15 the same morning, and arrive at Denver at 2:30 P.M. June 5.

Space has been engaged on this train for the following Eastern delegates: C. O. Baker, Jr., N. F. Brady, D. A. Bertolette, W. H. Blood and wife, J. F. Blauvelt, P. C. Brown, Charles B. Burleigh, H. J. Buddy, A. E. Carrier, C. H. Coit, H. F. Coggeshall and wife, J. S. Codman, W. P. Conover and wife, E. Corrigan, H. C. Cushing, Jr., H. P. Chandler, A. J. De Camp and wife, Miss De Camp, A. F. Dow and wife, W. C. L. Eglin, Miss Eglin, W. R. Eaton and wife, H. W. Fitz, D. Farrand and wife, S. S. Gleason, W. R. Gardner, W. P. Hancock, H. T. Hartman and wife, R. C. Hall, H. W. Hillman and wife, C. I. Hille, W.E. Holmes, C. H. Hodskinson and wife, Bert Houghton, Percy Ingalls and wife, E. H. Johnson, Harry Kirkland, C. A. Learned, C. E. Lucke, C. W. Lee, E. T. McCabe and wife, J. B. McCall and wife, N. C. McPherson, George Manson, T. C. Martin, K. G. Martin, Miss. Martin, W. E. Moore, H. P. Moore, Francis Murdock, I. E. Moultrop, A. H. Patterson, Warren Partridge, C. W. Price, George F. Porter, J. S. Pyle, H. E. Ryder, E. F. Rowell and wife, E. W. Rockafeller, Paul Spencer and wife, J. C. Spear and wife, H. L. Shippy, H. D. Simpson and wife, Orin Smith, George B. Stetson, George L. Smith and wife, C. E. Skinner and wife, Miss. Skinner, J. W. Wakeman and wife, Arthur Williams, J. S. Whitaker and P. S. Young.

A High Grade Bureau for Technical Employers and Employes.

In 1893, Frederick A. Peckham, at that time Western manager of the "Engineering News," in traveling over the country, had constant demands made upon him for competent help by technical companies, manufacturing interests and the like. In addition he was visited daily by men who wished him to help them to secure positions. Herein was the great need.

To meet this need, the Engineering Agency was started by Mr. Peckham, Monadnock Block, Chicago. During the 12 succeeding years, this Bureau has filled approximately 10,800 positions with competent technical men. This means that the wants of 21,600 employers and employes have been satisfied. One feature has been the supplying of instructors and professors for the principal colleges of engineering. It is significant that all these 10,800 men have been placed at maximum salaries. To-day, the agency has 500 open positions on its books. They must and will be filled. More men are coming. More vacancies are coming. The scope of the business is increasing magically. During the past two years, the registrations have exceeded 4,000. And still there is room. To reach the men needed, the Agency regularly uses the "want" columns of over 200 publications. It has spent thousands of dollars in advertising. And yet even this strenuous method has not coped adequately with the exigency. It has been necessary for the Agency to publish a new monthly journal, the "Engineering World." This publication has jumped into immediate popularity and surprised all connected with it. Inasmuch as it acts as an intermediary or agent between employer and employe, it stimulates hearty co-operation, in which neither forgets or neglects the other, and is unique in covering a broad and fertile field. It aims to be simple, interesting, of practical value. By such heroic measures as the foregoing, has the Engineering Agency met great needs.

Applicants for membership give complete records of past experience, and furnish references as will guard the Bureau in placing only skilled men. The experience of years, a reputation for unimpeachable reliability with the leading railroad, manufacturing and industrial companies, and up-to-date methods have made the Engineering Agency an influential corporation, whose assistance and counsel is sought by all classes from all parts of the civilized world.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MAY 9, 1905.

Electric Railways and Appliances

789,171. Electric Signal System for Railways. Ara P. Rickmire, Rhinelander, Wis. Filed Aug. 11, 1904.

789,221. Electric Safety Appliance for Railway-Trains. John A. Larkin, Glen Ridge, N. J. Filed Nov. 12, 1903.

789,225. Underground Conduit for Electric Railways. John H. Munson, Chicago, Ill., assignor of one-half to Charles G. Hawley, same place. Filed July 10, 1896.

789,340. Contact Apparatus for Electric-Traction Systems. Ellsworth Sperry, South Windsor, and David F. Broderick, Hartford, Conn. Filed Nov. 4, 1904.

789,383. Electric Trolley. Charles L. Rogers, Uxbridge, Mass. Filed Nov 30, 1903.

789,613. Trolley-Wire Splicer. William L. Kerlin, Wyoming, O., assignor of one-half to Josiah Kirby, same place. Filed Jan. 4, 1905.

789,649. Electrofluid-Pressure Switching Mechanism. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, same place. Filed Jan. 18, 1904.

789,666. Trolley. James W. Patterson, Cutler, O. Filed Jan. 5, 1905.

Electric Lights and Appliances

789,519. Electric-Drop-Light Bracket. Carl E. Zeisinger, Durand, Wis. Filed Aug. 13, 1904.

789,540. Globe-Holder. Charles E. Harthan, Lynn, Mass., assignor to the General Electric Company. Filed Feb. 9, 1903.

789,609. Arc-Electrode. Duncan A. Holmes, Samuel A. Tucker and Edward Van Wagenan, New York City. Filed Aug. 6, 1904.

789,618. Apparatus for Automatically Lighting Smudge-Pots. Henry H. Lyon, Riverside, Cal. Filed Nov. 21, 1903.

Electrical Machinery and Apparatus

789,365-366. Electric Snap-Switch and Electric Switch. Monroe Guett, Hartford, Conn., assignor to the Hart & Hegeman Manufacturing Company. Filed Nov. 16 and 18, 1903.

789,367. Electric Switch. Henry F. Keil, Bronxville, N. Y. Filed July 19, 1904.

789,377. Unsymmetrically-Wound Electric Motor. Frederick J. Newman, Chicago, Ill., assignor to the Woods Motor Vehicle Company, same place. Filed Jan. 9, 1905.

789,379. Static Electric Machine. Theodorus H. Patee, Greenfield, Ind. Filed June 14, 1901.

Telephones and Telephone Apparatus.

789,188. Combined Drop and Jack for Switchboards. Henry Tideman, Menominee, Mich. Filed Aug. 13, 1904.

789,208. Signal Instrument for Telephone-Substations. Henry M. Crane, New York City, assignor to the Western Electric Company, Chicago, Ill. Filed Jan. 2, 1904.

Miscellaneous.

789,161. Dental Electrode for Medicamental Diffusion. Samuel H. Linn, Rochester, N. Y. Filed Sept. 30, 1903. Renewed Sept. 19, 1904.

789,215. Apparatus for Galvanizing or Otherwise Plating Wire or Other Metallic Bodies. George A. Goodson, Providence, R. I., assignor to the Goodson Electric Galvanizing Company Minneapolis, Minn. Filed April 7, 1904.

789,239-240. Electric Signal System. Howell W. Souder, Tamaqua, Pa., assignor of one-half to W. D. Zehner, Lansford, Pa. Filed May 16 and 26, 1904.

789,256. Electrical Test Set. Alva J. Carter, Ida Grove, Iowa. Filed Dec. 23, 1902. Renewed April 4, 1905.

789,295. Electrical Cut-Out. William D. Packard, Warren, O. Filed May 8, 1903.

789,353. Plant for the Electrodeposition of Metals. Anson G. Betts, Troy, N. Y. Filed April 11, 1904.

789,378. Apparatus for Teaching Telegraphy. Howard G. Page, Fitchburg, Mass. Filed Sept. 26, 1904.

789,402. Electrical Collector. Peter Ackermann, Chicago, Ill. Filed Sept. 4, 1902.

789,411. Charging-Station for Electrically-Propelled Vehicles. Frank P. Cox and Charles E. Holmes, Lynn, Mass., assignors to the General Electric Company. Filed June 13, 1901.

789,419. Magnetic Controlling Device. Charles E. Eveleth and Oran O. Rider, Schenectady, N. Y., assignors to the General Electric Company. Filed June 3, 1903.

789,456. Automatic Rheostat. George H. Rupley, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 20, 1901.

789,458. Lightning-Arrester. Howard R. Sargent, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 28, 1902.

789,463. Reactive Coil. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed Oct. 1, 1904.

789,475. Circuit-Breaker. Jonathan E. Woodbridge, Schenectady, N. Y., assignor to the General Electric Company. Filed July 3, 1902.

789,488. Synchronism-Indicator. Paul L. Clark, Chicago, Ill., assignor to the General Electric Company. Filed Oct. 19, 1903.

789,508. Attaching-Plug. Howard R. Sargent, Schenectady, N. Y., assignor to the General Electric Company. Filed Oct. 9, 1902.

789,514. Storage-Battery Plate. Charles H. Whiting, New York City. Filed June 25, 1904.

789,515. Leading-in Conductor. Willis R. Whitney, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 14, 1904.

789,523. Process of Electrolytically Refining Copper-Nickel Alloys. Anson G. Betts, Troy, N. Y. Filed April 11, 1904.

789,573. Insulator. Louis Steinberger, New York City. Filed July 17, 1903.

THE TELEPHONE WORLD.

California Independent Telepone Association Organized.

At a meeting held in Los Angeles May 5, in the office of the Home Telephone Company, an association of the Independent telephone companies was formed, to be known as the California Independent Telephone Association.

The aim of this organization is to bring about a closer relationship between the various Independent telephone companies operating in California. Meetings will be held the second Tuesday is each month, when matters pertaining to the betterment of service, the requirements of the various communities will be considered and acted upon. Constitution and bylaws were adopted and the following officers were elected:

President—John Van Liew, of Los Angeles.

First Vice-president—D. S. Parker, of Pomona.

Second Vice-president—Roscoe Howard, of San Diego.

Secretary—P. T. Spencer, of Whittier.

Treasurer—Will L. Frew, of Compton.

It is stated that few people realize the progress the Independent telephone movement has made in Southern California. The fact was brought out at the meeting that more than $10,000,000 is invested in telephone plants of the various Independent companies who are now operating 30 exchanges with over 30,000 telephones and toll line circuits reaching 110 towns in Southern California. All this being accomplished in less than two years.

A Clock to Regulate Telephone Talk.

A dispatch from Paris states that the Paris telephone administration has introduced into its public offices a register with a clock face —like the taximeter —the circumference whereof indicates 12 minutes, divided into units of conversation periods, namely, three, six and nine minutes When the machine is set going the person using the telephone can see precisely how long he has been speaking.

The Pennsylvania Telephone Company is about establishing an automatic exchange at Fleetwood, similar to those at Palmyra and Birdsboro. The necessary number of subscribers having been secured, the men are now engaged in arranging the details. The subscribers live in Fleetwood and surrounding districts.

The Valdez, Marshall Pass & Northern Railroad has been incorporated, to build and operate a railroad and telegraph and telephone lines from the eastern shore of Valdez Bay, 413 miles, to Eagle City, on the Yukon River, Alaska.

At a recent meeting of the selectmen of Newport, Me., it was voted to give the Plymouth Telephone Company the right to erect poles and to string wires on the streets of that village and it is understood that this will be done at some time in the near future.

In Robeline, La., a telephone system has been subscribed for, both long-distance and local, and its construction is in progress.

Annual Meeting Shows Rapid Extension.

The Nuckolls County Telephone Company held its annual meeting in Nelson, Neb., this month, and nearly all the shares that have been issued were represented. A statement of the company's condition shows total expenditures to date are $15,472.31; total indebtedness, $7,677.22; material on hand, $2,062.00; average investment for year, $4,360; rents and tolls to date, $1,609.56; operating expenses, $334.97. The capital stock was increased to $50,000, the time of the annual meeting was changed from May 1 to the first Tuesday in April, and the number of directors reduced from 17 to 7. After a lengthy and animated discussion it was agreed to issue bonds not to exceed $10,000.

The board of directors for the coming year was elected as follows: S. A. Lapp, J. C. Day, J. C. Chamberlain, B. F. Scroggin, J. A. Wehrman, W. A. Voigt and J. R. Parsons.

During its one year of operation the company has erected 127 miles of lines, installed 260 'phones and established exchanges at Ruskin, Nora, Cadams, Oak and Angus.

Telephone Bids Wanted.

The Interior Department has given notice that sealed proposals will be opened June 1 at the office of the U. S Reclamation Service Office, Glendive, Mont., for installing, in connection with the Fort Buford reclamation project, a telephone system having four telephone stations and about 70 miles of pole line, beginning opposite Glendive and ending at a point nearly opposite Fort Buford. Specifications, forms of proposal and particulars may be obtained by applying to the chief engineer of the Reclamation Service, Washington, D. C., or to F. C. Weymouth, engineer, Glendive, Mont.

Plans are being perfected by the Southern New England Telephone Company of Boston, Mass., for a rural service by which the farmers and others will have the use of telephones at a minimum cost of 75 cents per month. The farmers are to construct their own lines and furnish poles and labor, the company supplying wire and telephones. The farmers will own the lines and keep them in repair, the company keeping the telephones in order.

The Missouri, Kansas & Texas Telephone Company has filed a mortgage of $1,250,000 to the Old Colonial Trust Company of New York in the register of deeds' office Kansas City, Kan. The mortgage is to secure the 5 per cent. bonds issued in 1899, on wire and equipment.

The United States Government will establish in the fifth life-saving district a system of patrol telephones extending from Cape May to Sandy Hook. Work will begin soon that the system may be ready when the crews are put on, August 1.

The North Collins, N. Y., Telephone Company has increased its capital stock from $5,000 to $10,000.

The Goodhead Telephone Company, of Winchester, Ill, has changed its name to the Scott County Telephone Company.

Farmers Want Telephones.

At a recent meeting of the farmers of the southeast part of Oklahoma County, held in Oklahoma City, Okla., it was practically decided to put in a system of rural telephones, with city connections. The Pioneer Telephone Company of that city has made the farmers a proposition to furnish them with instruments and maintain the line at $1 per month after it is built. Some opposition was at first made to the city connection, but this was voted down almost unanimously after some discussion, as the convenience of the city connection was shown to be one of the most important features To start with there will be about 50 telephones, and these will have city connections so that the farmer may transact a considarable amount of business with his city brothers. This plan of communication is being established in many parts of the territory and is giving satisfaction.

Announcement was recently made that the Wayne-Monroe Telephone Company has secured possession of the Kelly exchange at Newark, N. Y. The Kelly system was established in the town of Arcadia several years ago and is now the largest system in any one town in Wayne County. It was recently overhauled and several thousand dollars spent in placing it in excellent condition. The deal is considered the most important one that has been made in several months in telephone matters. The toll business is large. It will be handled between the Wayne-Monroe and the Interocean into Rochester and Buffalo and Western New York. The board of directors has elected John A. Driscoll, general manager and president; Judson L. Transue, secretary and treasurer; Dr. J. S. Brandt, Albert Yeomans and Judson L. Transue, executive committee.

The recent annual meeting of the stockholders of the Albany, N. Y., Home Telephone Company was held at the Exchange Building. The following officers were elected: President, Howard Hendrickson; vice president, Irving H. Griswold; treasurer; George C. Lee, Jr.; secretary, Henry J. Prince, Jr. The annual report showed a gratifying increase in business and a large addition to the surplus and earnings of the company.

C. W. Scott, of the Deposit, N. Y., telephone exchange, is building a new line to Hambletville and China. He will also make connections with North Sanford as soon as possible.

The Northeastern Telephone Company is extending its lines at East Gorham, Me.

Telephone Incorporations.

The Albany Telephone & Telegraph Company, Albany, Me. Capital stock, $3,000. Officers: President, Amos G. Bean; treasurer, Lucius J. Andrews, both of Albany.

The Sherburne County Telephone Company, Elk River, Minn. Capital stock, $50,000; Incorporators: J. C. Jacobson, George Patterson, Charles F. Knapp and Jesse A. Gutzler.

The Coventry & Greene Telephone Company, Greene, N Y. Capital stock $1,000. Incorporators: Dr. George O. Williams, Dr. Frank Preston and Matthew F Smith, Coventry.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Auburn, N. Y.—The city council has let the contract for lighting the city with electricity to the Auburn Light, Heat & Power Company.

Glenwood, Ia.—The Glenwood electric light plant is to be enlarged and improved.

Guthrie, Okla.—The Guthrie Electric Light & Power Company, of which Thomas H. Smith is president, will enlarge its plant in the near future.

Harrington, Wash.—Mr. Brodie, of the firm of Shaw & Brodie, promoters of the Harrington electric light system, will soon complete the light plant here.

Haverhill, Mass.—E. P. Shaw has made a proposition to the Amesbury Electric Light, Heat & Power Company to supply electric light at Salisbury Beach.

Knoxville, Ill.—It is probable that the Electric Light Company of this city will extend its wires to Gilson and Maquon.

McComb, O.—The electric light plant has been purchased by this town for $5,000. Bonds will be issued to pay for the same.

Minneapolis, Minn.—A central lighting plant, supplying both gas and electricity, will be established in this city at a cost of about $50,000.

Monmouth, Ill.—This city has informally made an effort to purchase the electric light plant of the Monmouth Gas & Electric Company, and the matter is receiving the consideration of the officials of that company.

Paducah, Ky.—Work has been commenced on the construction of a new electric light plant here. David G. Wright, of St. Louis, Mo., representing St. Louis and New York capitalists, may be addressed.

Portland, Me.—The Centerville Light & Traction Company, of this city, capitalized with $500,000, has been incorporated by M. W. Baldwin, H. E. Mason and others, to operate an electric lighting plant.

Robeline, La.—This town is to be supplied with electric lights.

Rose City, Mich.—The Rose City Manufacturing Company is figuring on putting in a city electric lighting plant. Andrew King, an electrician of Bay City, has been figuring out the cost. Superintendent W. A. Humphrey will confer with Greif Brothers, of Cleveland, who own the plant of the company and thinks it probable that the city will soon be lighted by electricity.

Sandy Hill, N. Y.—The Glens Falls Electric Light Company has been given a 50-year franchise to operate in this village. Under the terms of this franchise the company must furnish incandescent lights for 10 cents per kilowatt hour, and supply current for manufacturing purposes at 5 cents per kilowatt hour.

Tower City, Pa.—H. T. Bressler has completed arrangements for the erection of a new electric plant to provide lights for this city, Williamstown, Lykens, Wiconisco, Reinerton and Johnstown. The plant will be located here.

Waterford, N. Y.—The Waterford Electric Light, Heat & Power Company has filed a certificate of increase of capital from $50,000 to $500,000.

Wynnewood, I. T.—This city will soon have electric lights.

STREET RAILWAYS.

Adrian, Mich.—The Toledo & Michigan Electric Railway Company, which plans to build an electric line between this city, Clayton, Janesville and other places, is offering for sale several blocks of its bonds. P. P. Duket is president of the company.

Amboy, Ill.—It is learned from a reliable source that the Illinois Central Railway Company plans to operate suburban service between here and Freeport by electric power instead of steam.

Atlanta, Ga.—Active steps have been taken looking to the immediate construction of the Atlanta-Macon Interurban Railway, a proposed new trolley line between this city and Macon.

Boyertown, Pa.—The city council has granted a franchise to the Boyertown-Palm Electric Railway Company to lay tracks on Reading and Philadelphia avenue, conditioned on the payment of $1,000 if the road is not built within one year, but with the clause "unless hindered by legal obstructions" not included. This proposed line will connect this city with the Oley Valley line, and passing through Gilbertsville, will form a connection at Limerick with the Schuykill Valley line.

Brookings, S. D.—Madison business men are considering the proposition of putting in an electric railway line from this city to Salem.

Catskill, N. Y.—The Catskill Electric Railway Company has filed with the Secretary of State a certificate of an extension of its lines in this town.

Clinton, Ill.—J. G. Eversham, private secretary of William B. McKinley, the electric railway magnate, was lately present at the meeting of the city council and was granted a franchise for the establishment of an electric line.

Elgin, Ill.—It is reported that an electric road will be built on the north route through Garden Prairie, Marengo and other cities.

Findlay, O.—An increase in the capital of the Lima, Findlay & Toledo Electric Railway has been made from $700,000 to $900,000.

Ft. Wayne, Ind.—J. Levering Jones, of Philadelphia, will erect an electric line between this city and Marion.

Hamilton, Tex.—S. S. Wright, one of the directors of the Municipal Bond & Trust Company, has closed a contract to build a trolley line from Dublin to this city.

Kansas City, Mo.—An electric line will be erected to connect this city with Excelsior Springs.

Lansing, Mich.—Jacob Stalb and Fred Thomas, the original stockholders of the company organized to construct the Lansing & St. John Electric Railway, will soon begin work.

Mexico, Mo.—It is announced that an electric line will be built from Jefferson City through here and north of Eldon, Ia. J. E. Houghan is interested in the enterprise.

Philadelphia, Pa.—The Philadelphia Rapid Transit Company will shortly award a contract for an addition to its power house in Wyoming avenue east of Third street. W. S. Twining, chief engineer, has the plans in his possession.

Red Bluff, Cal.—The California Promotion Committee is advised that a franchise has been granted and rights of way obtained for an electric railroad from here to Tuscan Springs, a distance of nine miles. Surveys have already been made, and it is said development work will start in 90 days.

San Francisco, Cal.—W. M. Gibson, of this city, has asked for a franchise in Santa Cruz, for an electric railroad from Chittenden to Watsonville.

Santa Ana, Cal.—The Pacific Electric Company will push construction on a line to this city and hopes to have it completed by October 1. The route is straightaway from Watts station to Santa Ana, a distance of 27 miles. The line from Huntington Park to Newport Beach also will be built at once.

Shawnee, O. T.—A franchise has been granted by the council of Tecumseh for an electric railway in that city, with the proviso that the promoter, Alfred Hart, president, of the Exchange Bank there, shall commence construction of a line to this city within 90 days. Mr. Hart put up a $5,000 bond to do the work. The two cities are only a short distance apart, and the new line will be connected here with Shawnee's electric line.

Terre Haute, Ind.—Tucker, Anthony & Co., have financed and will shortly build a high speed electric interurban road between Indianapolis and this city.

Waterloo, Ia.—The Mason City and Clear Lake Railway and the Waterloo, Cedar Falls & Northern Railway will consolidate the two systems, and contemplate constructing electric lines from Mason City to Waverly and from Sumner to West Union.

POWER PLANTS.

Albany, N. Y.—The Electric Power & Transmission Company of Niagara County has filed articles of incorporation with the Secretary of State. It has $5,000,000 capital, and may operate anywhere between Albany and Buffalo. Its directors are Edward B. Bruce, Allan C. Rearick, Edward E. Stowell, Frank H. Cole, New York, and John J. Daly, Brooklyn.

Riverside, Ill.—The Chicago & Southern Traction Company has purchased a site here and will erect a large power plant to cost about $100,000.

BIDS WANTED.

Washington, D. C.—Sealed bids will be received until May 31 at the office of Commissioners Henry B. F. McFarland, Henry L. West and John Biddle, for the construction and installation of a heating, lighting and power plant at the Industrial Home School at Blue Plains. A certified check for $1,000 is required.—The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until May 31, for furnishing various Eastern navy yards with the following supplies: Schedule 251, electrical wire; Schedule 253, battery cells; schedule 254, motors; schedule 256, insulating tape, etc. Blank proposals and detailed information can be obtained at the Navy Pay Office in New York, or upon application to the Bureau in this city. The Bureau will open bids on June 6, for furnishing an electric traveling crane. Intending bidders should call for schedule 245, which can be obtained at the Navy Pay Office in New York, or upon application to the Bureau.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 14⅞@15c.; Lake 14⅞@15c.; casting, 14⅝@14¾c.

The annual meeting of the Kansas City Railway & Light Company will be held in Jersey City on June 26.

The recent decline in the shares of the American Telephone Company (Bell) from 144 to 137½ has excited considerable interest.

The city of Chicago will appeal from Judge Grosscup's decision in the 99-year case whether the Union Traction Company does or not.

The American Graphophone Company has declared a dividend of 1 per cent. on its common stock, payable June 15, to holders of record June 1.

The annual report of the Chicago Edison Company recently made public shows an increase in net earnings of $100,995. Dividend payments increased about $70,000.

The American Railways Company (Philadelphia) has declared the regular quarterly dividend of 1½ per cent., payable June 15 to stock of record May 31.

The annual report of the Commonwealth Electric Company of Chicago shows an increase in net earnings of about $72,000 and an increase in gross earnings of about $450,000.

President John I. Beggs of the National Electric Company, Milwaukee, Wis., who was recently elected to succeed S. W. Watkins, announces that the company would either be reorganized or sold to outside persons.

E. W. Moore of the Everett-Moore Syndicate says that the Toledo (O) Railways & Light dividend will probably be increased to 3 per cent. and finally to 4 per cent. He says the present dividend rate will surely be maintained.

The Montreal Street Railway Company announces that the issue of $1,000,000 bonds for extensions has been indefinitely postponed. Legal formalities must be arranged before the shareholders can be asked to ratify the issue.

At a meeting of the board of directors of the Columbus (O.) Edison Electric Lighting Company, the regular quarterly dividend of 1¼ per cent. was declared on the common stock of the company, payable June 1. The books will close May 20.

August Belmont, president of the Interborough Rapid Transit Company of New York, said that the proceeds of the $10,000,000 short time notes sold by the company to a syndicate last week, as reported in ELECTRICITY, are to be used for the payment of equipment and extensions.

The General Public Service Corporation and the Universal Service Company, two corporations formed for supplying gas and electricity for light, heat and power purposes in the cities and towns of the State of New York, were incorporated at Albany on Friday with capitalizations of $2,000,000 and $100,000, respectively.

Stockholders of the Twin City Rapid Transit Company are asked to approve the action taken by the directors May 5 looking to an increase in the common stock of $5,000,000. It is explained in the circular that in order to amend the certificate of incorporation it will be necessary that two-thirds of each class of stockholders assent to the proposed amendments, and for the purpose of voting on them a special meeting of the stockholders will be held at the company's office in Elizabeth, N. J., on May 31.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price May 13
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	203½
Manhattan Elevated Railway	164⅞
Metropolitan Street Railway	115⅜
Metropolitan Securities	76
Ninth Avenue	197
Third Avenue	124
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	60⅜
Brooklyn City Railway	240
New Orleans Railway	4½
Public Service Corporation (New Jersey)	121
Philadelphia.	
Consolidated Traction of New Jersey	83¼
Philadelphia Traction	99¾
Union Traction	61
Boston.	
Boston Elevated	157
Massachusetts Electric Companies, com	18¼
do. do. do. pref.	66
West End Street, com	97½
do. do. do. pref.	116½
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	7¾
do. do. pref.	45
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	15¼
do. pref.	54
Electric Boat, com	87
do. do. pref.	75
Electric Lead Reduction	½
Electric Vehicle, com	12½
do. do. pref.	20
Westinghouse, com	171½
do. pref.	190
General Electric	177½
Boston.	
Edison Electric Illuminating	250
General Electric	177½
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	155
National Carbon, com	62
do. do. pref.	114
Philadelphia.	
Electric Company of America	11⅞
Electric Storage Battery, com	81
do. do. do. pref.	81
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	139
Western Telephone Company	18
New England Telephone Company	138½
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210½
Mexican Telephone Company	1¾
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92⅞
Chicago Telephone Company	125
MISCELLANEOUS STOCKS.	
Otis Elevator Company	52
Consolidated Car Heating	64
Standard Underground Cable	200

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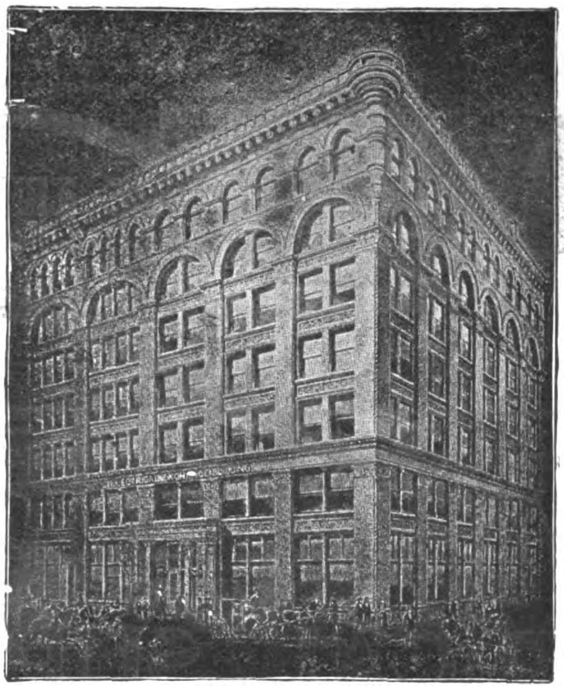

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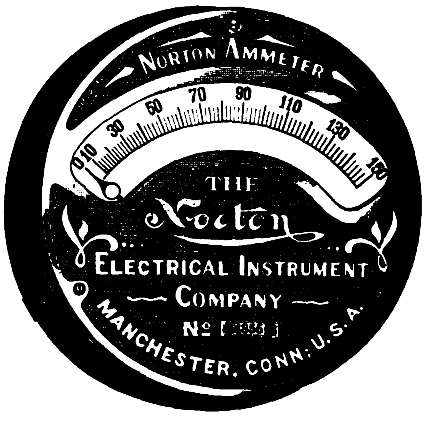
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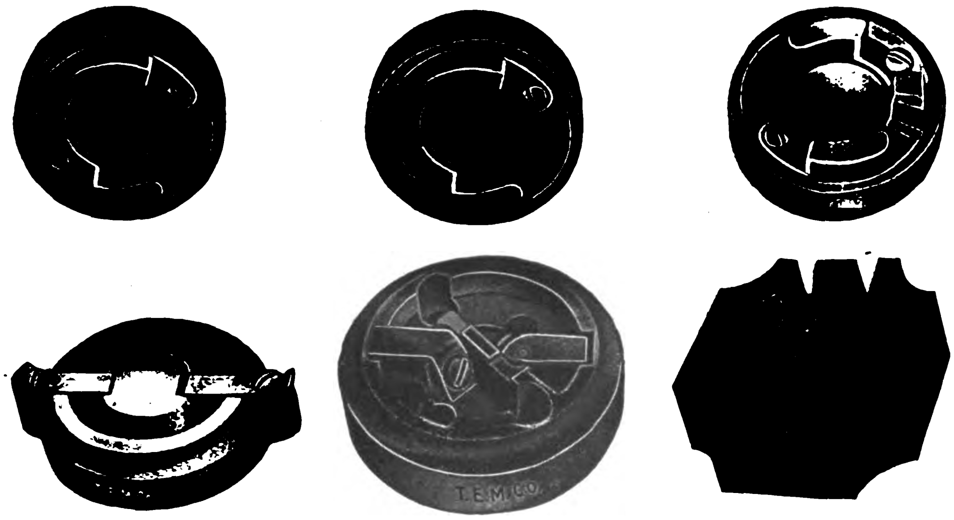

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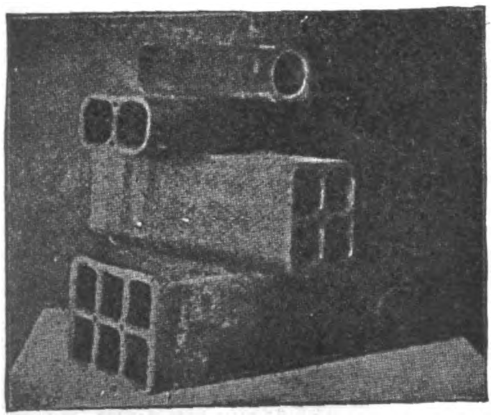

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EDITORIAL NOTES.

What Tunneling Owes to Electricity.

American enterprise is directing much of its energy in the construction of tunnels. It has taken many years for us to awaken from the conservatism and lethargy into which we had fallen with respect to our transit facilities. Since the awakening, however, a remarkable change of opinion has been observed. The horror of traveling through tunnels, felt by many, whose impressions of them were based mainly upon those observed in England, has passed away. If anything can be stated in this respect, it is that the people of Greater New York are now clamoring for them. A sudden change of attitude like this is well worthy of a moment's consideration. The tunnel problem has been one of ventilation as well as construction. The modern appliances now in use permit not only of rapid excavations, but of construction that is beyond criticism. The difficulty remaining was that of ventilation. All who have passed through tunnels connected with our steam lines remember the unpleasantness associated with that part of the road. The necessity for closing windows to shut out the foul air; and in summer, the stifling heat, that thus resulted. Vivid experiences of a personal nature are rarely forgotten, and for this reason, tunnels in our country were considered as part of the necessary unpleasantness of travel. The apparent lethargy was more an active distaste from this point of view. Since the electric car has been brought to its present magnificent point of perfection, the problem has been successfully solved. All honor to the mechanical and civil engineer in their admirable work in this respect. Their honors, however, are only possible through the use of electricity. The situation to-day can only be clearly understood by a keen remembrance of what tunneling owes to this strange force—electricity.

* * *

A Revival of Interest in Electric Lighting.

Electric lighting embraces great fields of activity. It is the influence through which the waterfall, the tide, the waves and the wind have been harnessed. Through it, the mining of coal has been greatly increased. It has become, in a sense, a national industry.

An unusual revival of interest in electric lighting has recently taken place, due to certain innovations now in contemplation. An examination of the situation discloses the strange fact, that the mechanism of the electric light station is undergoing radical changes. Various influences have been co-operating to produce this effect. In the first place, the ground space in cities is increasingly expensive, and in consequence engines occupying a large number of square feet are a source of annual expense not at all compensated for by their other qualifications. The boiler room must of necessity be contracted to meet with this new condition of affairs, and it is obvious that the only outlet in this respect is that of raising the pressure within them. Thus it is seen that floor space being expensive, has led to the installation of vertically mounted in preference to horizontal engines and high pressure in preference to low pressure boilers. A well-known consulting engineer in commenting upon the situation said: "The architects who have been laying out the building requirements of electric light stations are surprised at the changes that have been introduced lately." A few years from now, and this new and present revival will have been the means of creating a new and distinct departure in this field. Many things are hanging fire at present, not the least of which is the ultimate design of our most modern electric light stations.

* * *

The Education of an Electrical Engineer.

Considerable has been written from time to time as to the methods that should be adopted in training would-be electrical engineers. Some experts advocate one method, some another. In a recent issue of the "Electrical Magazine," Mr. H. H. Broughton suggests a system which would seem to have much to recommend it. His plan is to send the men into the works directly after they have completed their elementary education—say, at fifteen years of age, and keep them there for three years, working 50 or even 60 hours per week. At the end of this time college-train them for three years, and then finish off their education with another year in the works. The advantages of this system over the others are: That a man goes to college with a very fair knowledge of practice; he is conversant with the various processes; he knows something about the properties of materials and machines; and, further, he is fully alive to what will be expected of him when he rubs shoulders with the world. That the men start studying for their profession at an age when they are most capable of doing so, and when they realize the hard grinding work necessary to make a successful career, are in themselves sufficient recommendations for the system. As to the colleges, in the first place, every professor in an engineering department should be a practical engineer, or at any rate should be conversant with the needs of the engineer—particularly the lecturers on chemistry, physics and mathematics, above all. If the mathematicians would base their lectures to engineering students on practical problems, our colleges would pour into the country men armed with the tools necessary for tackling any problem they are likely to come across in their everyday work.

Unfortunately very few professors are practical men. Many of them may have been practical at one time, but years devoted to teaching has necessarily made them theoretical. And that such is the case, is not to be wondered at, in view of the fact that an up-to-date engineer, thoroughly conversant with practice and theory, can earn a year at least several times the salary usually paid to a professor.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

New York City has purchased three sites for electric plants, two in Long Island City, and one in Manhattan. These plants are not intended to supply private consumers.

The delegates to the International Railway Congress on the short tour were the guests of officials of the General Electric and American Locomotive Companies in Schenectady, N. Y., on Saturday. A series of tests of the New York Central's electric locomotive No. 6,000 were made.

A series of 10,800 photographs of the New York Subway in operation between 14th and 42d streets was taken Sunday noon with the aid of a battery of Cooper-Hewitt electric lamps, powerful enough to light a city of 50,000 inhabitants. But 12 minutes were required and more light was crowded into the tunnel than ever before was confined in like space. The pictures are for the private use of August Belmont and will be placed in his home.

Three of Nikola Tesla's patents covering the alternating current motor expired May 1. Referring to the subject, Mr. Tesla is reported as saying: "Three-fourths of the electrical business of the world is based on the three patents that have expired. Seven or eight years of the time of the patents were wasted before I could get the world to appreciate their importance. Since I secured them I have obtained 36 or 40 other patents along the same general lines, and many of these patents are still running."

Operating tests of the new electrical equipment of the Long Island Railroad were made last week along the 5-mile stretch of track between Aqueduct and Hammels, on the Rockaway Beach division. The third-rail is equipped with a wooden guard, and in addition third-rail sections are inclosed with picket fences. Elaborate new cattle guards have been provided. All the third-rail has now been laid, save a section of somewhat more than a mile along Atlantic avenue, and it is expected that passengers will be carried by electric trains by June 15.

A special to the "New York Times," from Denver, Col., May 20, says: "What is regarded as the richest known deposit of pitchblende, from which radium is obtained, has been discovered in Colorado. L. G. Nesmith, a mine worker is the owner. The value of the pitchblende is $2 a pound. Up to this time pitchblende has been found in crevices in rocks, scarcely thicker than a knifeblade, but Mr. Nesmith has followed his vein until he has found a large body of the ore. During a recent visit in Denver he exhibited a piece said to be the largest in the world. He has made one shipment to Germany, and will soon go there with a large lot."

In a paper recently presented before the International Railway Congress at Washington, Mr. Canovias of the Hungarian State Railways gave it as his opinion that electricity was the best illuminant for railway trains.

A skillful motorman, says our London namesake, can often save a considerable amount of power by taking advantage of down-grades and using the current judiciously. Generally speaking, it is the man who runs most of the distance with the controller at the "off" position who uses least current. When starting the car the power should be turned on so as to produce a strong, even pull until half speed or full speed is reached. To linger on the resistance points spells waste, and to force the motors to work much above their rated horse power also means loss.

A dispatch from Richmond, Ind., says that official confirmation was given there Saturday to the report that a merger practically has been completed for traction lines between Columbus, O., and Indianapolis, and that through dining and sleeping car service will be introduced. This is the first important step in a traction system that is to connect Pittsburg and St. Louis. It is being promoted by the Widener-Elkins syndicate of Philadelphia, which is investing millions in traction property in the Central West.

The 251st meeting of the New York Electrical Society will be held at the American Institute, 19 West 44th street, New York, Wednesday May 24, at 8 P.M. Mr. Charles A. Mudge, formerly chief engineer of the Railway Department of the A. E. G., Berlin, who took part in the tests on the famous Berlin-Zossen road, will lecture on "High Speed, Long Distance Electric Traction." At this juncture, when the conversion of steam railroads to electricity is commanding the anxious attention of the mechanical world, this lecture is fraught with unusual importance and is most timely.

ELECTRIC TRACTION IN SWITZERLAND.

BY EMILE GUARINI.

"Lives there a man with soul so dead" who, when conjuring up mental visions of the magnificent scenery of Switzerland, has not dreamed of one day visiting this corner of our globe where Nature seems to have collected together and concentrated a certain percentage of all those beauties which she has scattered lavishly throughout the various countries of the world?

He who has once seen Switzerland may claim to have seen practically the whole world in miniature displayed in an elegant manner which has a charm all its own, due to the vivid and clearly defined aspects that present themselves to him in such rapid succession that the variety presented recalls the passing of a panorama—in a word such an experience crowds all the pleasures of a lifetime into one brief hour.

Of all places in Switzerland Gruyere may, beyond all doubt, be ranked as one of the most beautiful, and it is a haven of refuge to the tourists in search of tranquility and pleasure; that its verdant and peaceful pastures have not been more visited by travelers is due, in the writer's opinion, to the long felt want of some really practical means of communication.

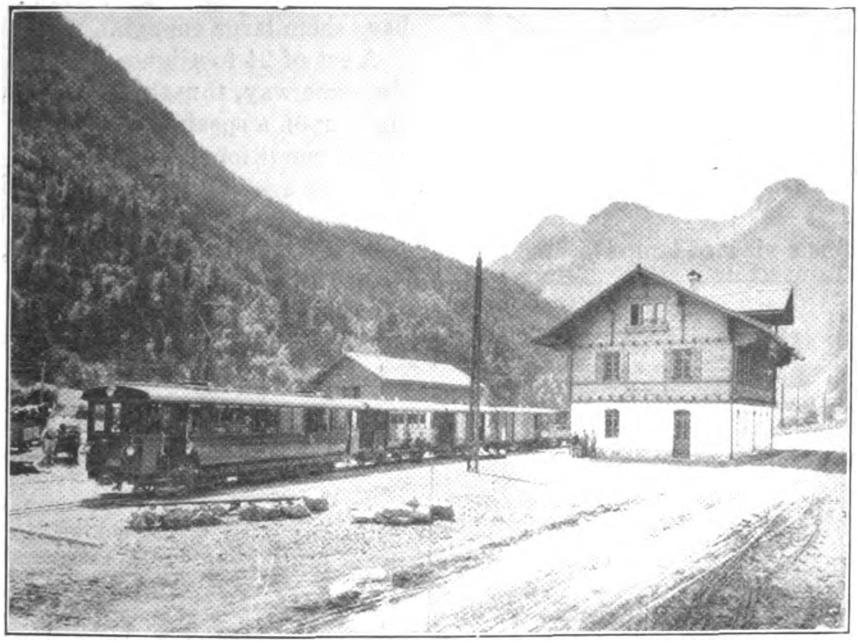
At the present moment only one line of electric railway traverses Gruyere; this line, of recent creation, is about 46.608 km. long and runs between Montbovon and Palezieux; the line, which winds through hilly country, passes through Albeuve, Grandvillard, Gruyere, Bulle, Semsales, Chatel-St. Denis, etc.

Montbovon, one of the termini, possesses as every one is aware an electric station for the supply of the necessary current to the electric railway service.

Like many other similar establishments in Switzerland, the Montbovon station uses as motive force the energy locked up in waterfalls, etc.; in this case it is derived from the River Saane, a tributary of the Rhine, which traverses the canton of Fribourg, passing through Grandvillard, Gruyere, Bulle and Fribourg.

As far as Bulle the line follows the course of the Saane almost entirely; at Bulle the track, which is generally single, trends to the southwest en route to Palezieux passing, as already stated, through Chatel-St. Denis.

The Montbovon station generates current at a high voltage which has to be reduced to a lower value. The transformation is carried out at Chatel-St. Denis, Bulle, Semsales and Albeuve, where there are located substations. At these substations we find special apparatus that receive the high tension currents and reduce them to a lower potential, under which form the energy is used for driving the electromotors which, as far as they themselves are concerned, drive the continuous current generators, the current from which is dispatched to the overhead copper wire that supplies it to the cars.



Montbovon Electric Station.

For this purpose these latter are fitted on top with a strong loop, the top part of which is formed by a bar of aluminum; this constitutes the bow or yoke that is held in contact with the line by means of springs for the purpose of conducting the current to the motors, as each car is fitted with four of them of greater or lesser power. With these various combinations of connections may be realized by means of the regulator or controller which the driver operates so as to render the consumption as low as possible.

Electricity is also used for lighting and heating the cars, and likewise for driving a small electric motor working a pneumatic engine that is used for braking purposes.

After having played its part in the cars the electricity returns to the generators; it makes or completes its circuit across the rails of the track and in order that it may not meet too high a resistance therein (all resistance being equivalent to a loss) the sections are all electrically connected by a special process.

As regards the contact or overhead wire it is suspended from brackets mounted on poles or from wires stretched between double poles or else fixed by means of insulators intended to arrest the vibrations passing over the wire.

If the extent of the work necessitated by the construction of an urban line of railway be borne in mind, then some conception can be formed of the difficulties presented by such an undertaking in such a hilly country as that of which we are speaking.

In such a case success can only be realized after long and exhaustive study. Too pronounced declivities must be avoided, all obstacles must be circumvented, rivers must be crossed and—in the present case—the gradients permitted were not to exceed 32.1 per cent., i.e., 32 m. per thousand meters.

Trains of 47, 60 and 130 tons circulate regularly at a speed of 17.20 km. per hour over the steepest gradients; they are composed of a motor vehicle to which the passenger cars are coupled as occasion may require.

The traveler is transported through magnificent scenery; on the one hand he sees rich valleys clothed with luxuriant verdure; on the other hand the line runs along a wood of sombre pines; further on he sees a lake of limpid water, the banks of which are romantic in their beauty; then upon the flanks of a mountain cosy villages peep out from amidst the trees whilst, towards the distant horizon, the eye is caught by some distant lofty snow-capped mountain.

In this way fresh scenes and pastures now are being opened up for the tourist—scenes which were hitherto inaccessible to him for lack of the necessary means of transport.

Lord Kelvin Recovering.

The health of Lord Kelvin is much improved and he was expecting to be able to leave London shortly for a change of air.

LIGHTING AN ASSEMBLY ROOM.

ARTICLE II.

BY W. H. WAKEMAN.

(*Concluded.*)

In this assembly room a gallery extends from side to side across the rear which covers nearly one-half of the seats on the lower floor. As no windows admit light to this part artificial light is always needed to make it compare favorably with other parts of the room. This is true of days when the sun shines brightly, therefore three groups of lamps are located here, as shown in Fig. 4, which is the ceiling as it appears from floor under the gallery.

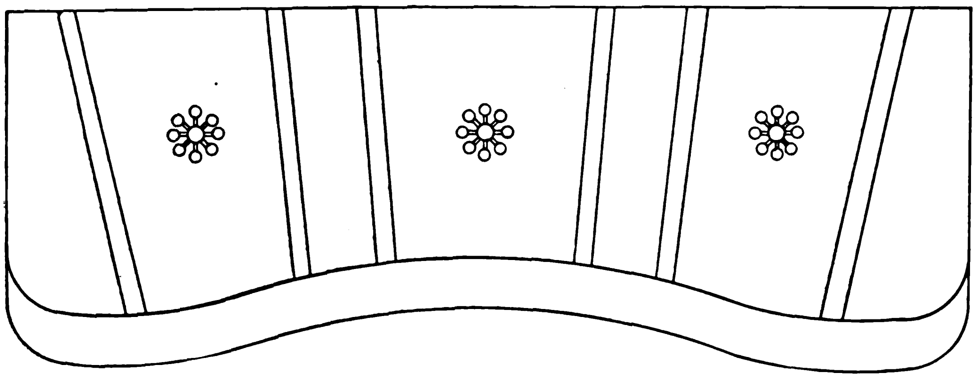


FIG. 4.

These are on one circuit, therefore the switch is kept thrown in so that whenever this room is used by throwing in the main switch these lamps give out a cheerful light. If it is in the daytime no others are wanted except where a stereopticon is used, therefore it is not necessary to go into the room for this purpose. When it is used in the evening for an illustrated lecture all overhead lamps are lighted until less light is wanted, when all but those shown in Fig. 4 are turned off. These are retained because they are not near enough to the stage to be detrimental, and it is not always wise to completely darken a room filled with young people, as it is a temptation to play pranks on each other that are not always agreeable.

On such occasions I have always turned off the lights promptly on the signal being given for this purpose, and turned them on equally prompt at the close of lecture, as this is an important point, because an audience will judge of the quality of service by small matters in the absence of more important ones. The stereopticon light is thrown on a clear white wall as this is superior to any form of screen which allows some light to pass through.

If the time of completion of lecture can be ascertained it is well to shut down the ventilating fans (or the motors which drive them) just before the lecture is completed as no furthur ventilation is required, and when the lamps are turned on their steady burning need not be disturbed by stopping these motors, for if this is done by pulling out a switch it is sure to cause lights to flicker. If the rheostat lever is thrown back carefully, one notch at a time, the speed of motors will be reduced gradually, thus avoiding any change that will be noticed by the audience. This suggestion applies to any occasion when the assembly room is illuminated.

Fig. 5 is a view of lamps located above the stage. They are fitted with opaque shades which throw light downward. These cannot be seen by the audience, as the illustration presents them as viewed from the extreme rear of stage looking towards the audience.

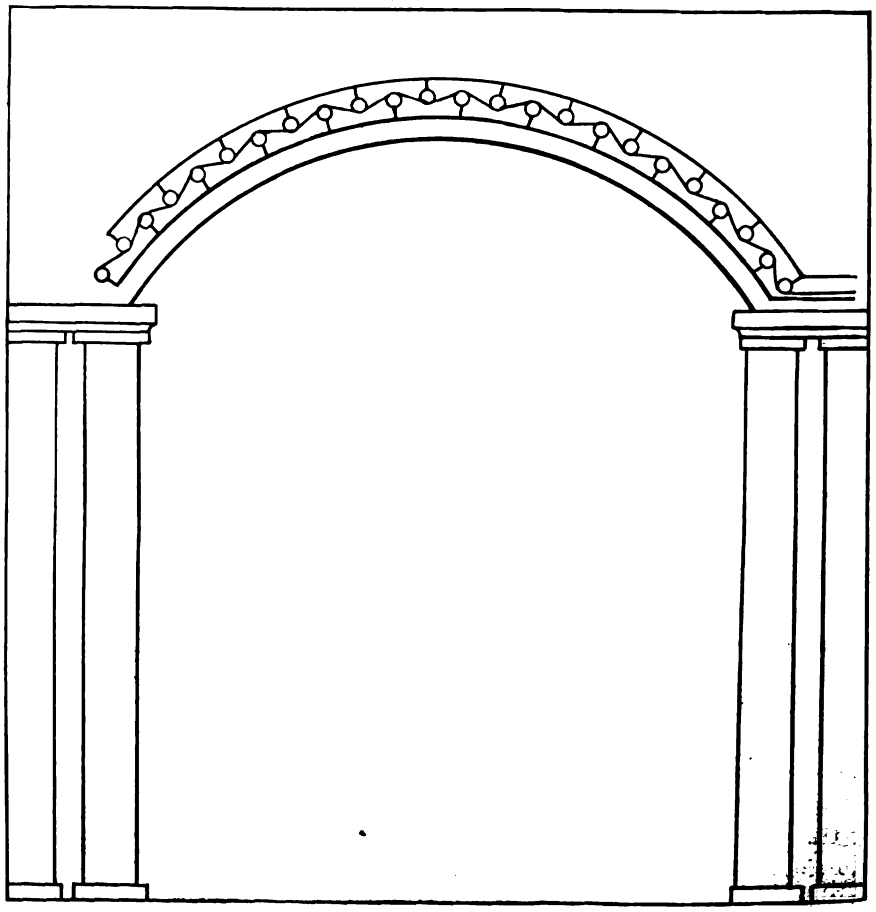


FIG. 5.

A unique plan was adopted for wiring these in order to light 12 of them first, giving an agreeable illumination which can be strengthened by turning on the 12 remaining. Three wires are used for this purpose, the upper and lower ones being positive while the middle is negative, and the operation is as follows:

When a switch controlling the upper and middle wires is thrown in current comes over the upper and feeds the 12 lamps connected to it, then returns over the middle. If this is not sufficient, another switch is thrown in, which sends current over the lower wire feeding the 12 lamps connected to it, then returning over the middle, which is thus caused to convey current enough for 24 lamps. If this was a large system it would be necessary to make the middle wire much larger than the others, but for a few lamps they are all of the same size, taking care to have them large enough.

A set of 24 footlights are arranged in the same way, thus throwing more or less light upon a speaker or an actor according to conditions.

Means are provided for darkening this rooom so that a stereopticon can be used, or other artificial effects secured, during the brightest day, thus making it possible to use it to the best advantage at all times.

The means used for darkening it does not interfere with its proper ventilation as it does in cases where a crude plan is adopted as, for instance, where heavy shades are used to darken windows that are the only source by which air can enter. It this case windows that admit light cannot be opened at any time, therefore when covered by heavy curtains air for ventilation enters through ducts in the usual way.

MAGNETIC BRAKES.

BY RALPH SCOTT.

Efficient electric railway service requires that the cars be quickly accelerated and rapidly retarded in order that stops may be made with a minimum loss of time. Fortunately an electric motor equipment possesses inherent means for accomplishing the latter purpose, which approach unto perfection. It is only of late years, however, that this principle has been applied advantageously and extensively, owing to the unexplainable reluctance of electric railway managers to accept what they had regarded as an impractical innovation.

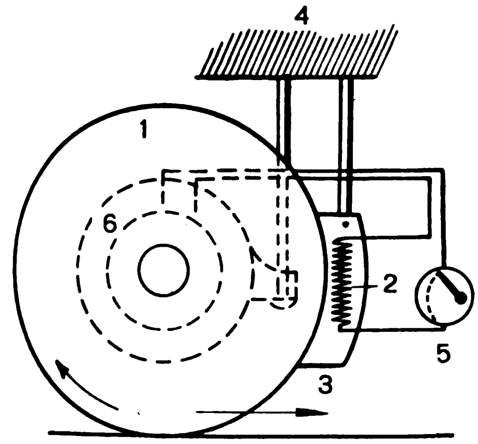


FIG. 1.

It is well known that a dynamo when discharging current into an external circuit must be supplied with an amount of mechanical energy theoretically equivalent to the watts expended in the entire circuit thus formed. This energy may be that of motion or translation. If, therefore, the energy represented by the inertia of a moving car can be expended in a circuit connected to the car motors (acting as generators) the car will be retarded by an amount proportional to the current given out by the motors.

Fig. 1 shows a diagram of an ideal brake embodying these principles. To the axle of the wheel 1 (moving in the direction of the arrows) is keyed the armature of the series motor 6. Connected in circuit with this motor is an electromagnetic brake-shoe, 2–3, and the adjustable resistance 5. The shoe 3 is securely suspended from the support 4, as is also a lug, preventing the field frame of the motor from turning. When the motion of the wheel is to be retarded the circuit is closed and all the resistance cut in. As the speed decreases the resistance is cut out so as to secure a practically uniform current, this being necessary owing to the constantly decreasing voltage. The braking effect is due to the three following causes:

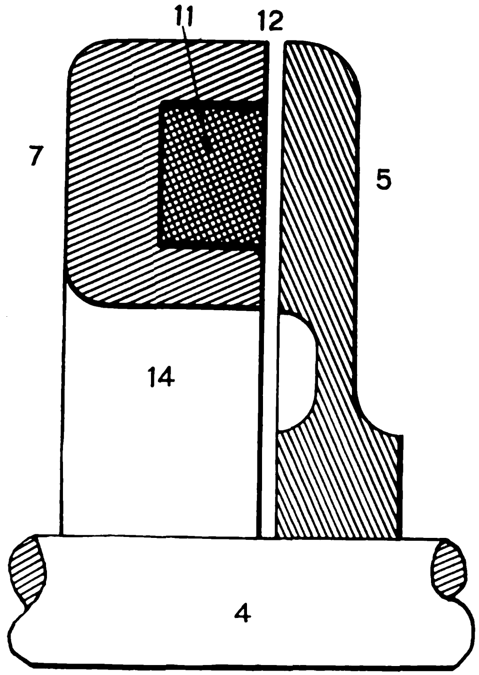


FIG. 2.

1. Friction of the brake shoe against the rim of the wheel.
2. Retardation of the motor, due to its acting as a dynamo.
3 Eddy current losses in both brake-shoe and rim of the wheel, due to the motion of the iron, which cuts the strong field.

These combined serve to produce a resultant that effectively stops the motion of the wheel. If gearing is used, a great strain is put upon the teeth of the gears unless the current is carefully controlled.

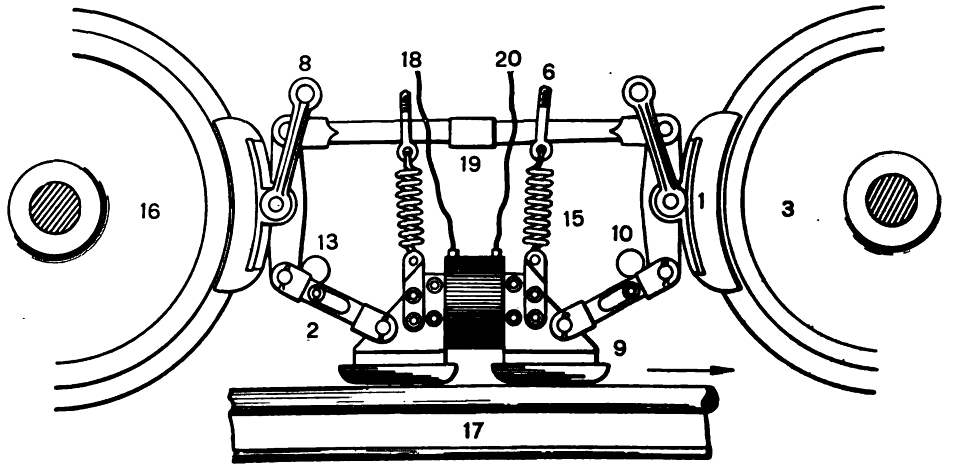


FIG. 3.

In Fig. 2, a brake which does not act upon the rim of the wheel is shown in section. To the axle 4 is keyed the cast-iron or the wrought spider 5. This moves close to a U-sectioned stationary ring 7, which incloses a coil 11. This coil is connected to the motors by a switch and in series with a variable resistance. When the switch is closed, the great flux passing through the magnetic circuit causes 5 to be strongly attracted, the air-gap 12 being reduced to zero. The braking effect is due to the eddy currents set up, the drag of the motors and the friction of the surfaces in rapidly moving contact.

In Fig. 3 is shown a form of brake that has been extensively applied. The terminals 18 and 20 of the coil are connected to the motors through a suitable switch and resistance, the shoes 9 being held a short distance above the rail 17 by the springs 15. Brake shoes 1, which are suspended near the rims of the wheel 16 and 3 by the links 8, are connected together and to the shoe part 9 by the links 19, 10, 13 and 2. The brake operates as follows:

If the car is moving in the direction of the arrow, the counter EMF. of the motors, when connected to the coil, sends a heavy current through the latter and thus produces a strong attraction for the rail. The friction and eddy currents tend to prevent its motion with the car, thus transmitting a pressure along 2 and causing 13 to force its shoe against 16; 13 being pivoted, part of the pressure is transmitted through 19 to the lever of the shoe. This lever, by being forced against the stop 10, presses 1 against the rim of 3.

The adhesion ratio of the truck is increased, due to the strong downward pull of the magnetic system. Skidding is thus prevented. A wet rail will not produce the pressure on the wheel shoes that a dry or sanded rail will, hence skidding is eliminated by the automatic variation of retardation that results.

By means of a diverter the current is kept within a safe limit. In moving down hill, the result of this constancy of current is to maintain a uniform speed of the car. If the current tends to increase (by increased voltage) the dragging effect increases, which in turn reduces the voltage and thus decreases the retardation. A change in resistance changes this critical speed, so that the motorman controls at will the speed of his car independent of the grade.

Fig. 4 shows a form of brake that finds application to stationary engine service. The rim of the flywheel 13 moves past the poles of the magnet 14, the curvature of these poles conforming to the crowning of the rim. The solenoid 9 is connected to a storage battery or to a dynamo driven by the engine. The magnet is prevented from moving with the rim by the loosely held links 11, secured to a stud solidly fastened. When the proper current is sent through 9 the flywheel may be stopped within one revolution whether the steam is on or not. As it is not usually necessary to make such rapid stops, a resistance is connected in series.

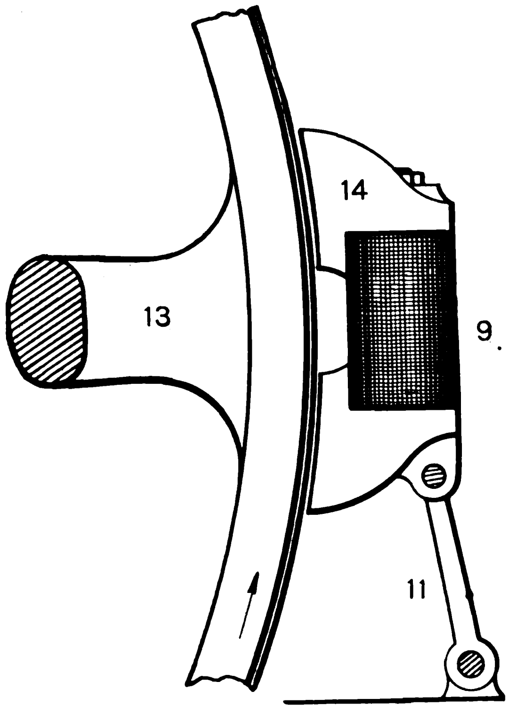


Fig. 4.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

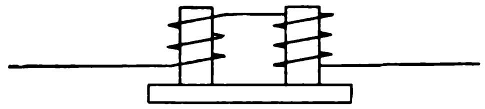
Telegraphy With Wires.

The Diplex System.—The practical principle employed in telegraphy for the purpose of obtaining different sets of signals over the same line is that of using certain keys to operate certain relays—one key, for instance, sending over the line a powerful current which actuates one relay, and another key controls the direction of the current and therefore can only operate another type of relay. The keys, therefore, are selective with respect to the relays. It is necessary to examine into the types of relays which can be thus effected. Such an examination will lead to a better comprehension of the meaning of a diplex system of telegraphy.

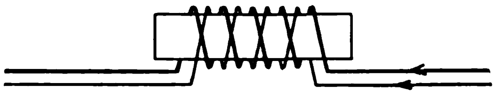
Kinds of Relays.—The relays may be classed according to the character of the current which will actuate them. They may be entitled as follows:

Neutral relay.
Differential relay.
Polarized relay.

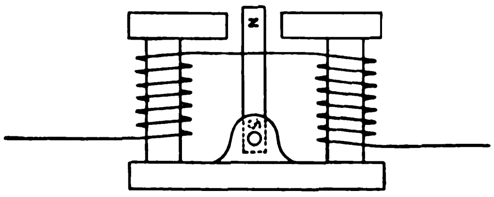
The neutral relay is, as its name implies, a relay operated by an ordinary current irrespective of its direction. Its only requisite must be sufficient strength to cause emphatic movement of its armature. It is simply an electromagnet, sensitive to a certain current whose strength is dependent upon its regulation.



NEUTRAL RELAY



DIFFERENTIAL RELAY



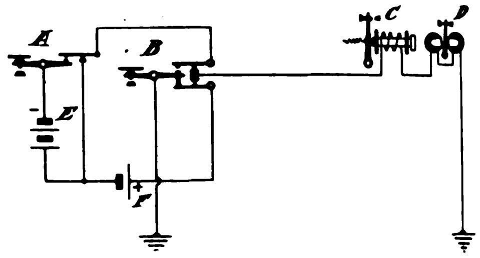
POLARIZED RELAY

Types of Relays used in Telegraphy.

The differential relay is an electromagnet possessing two distinct windings, each wound opposite to the other and each of exactly the same number of turns and resistance. The equivalence of the turns makes the magnetic effects alike, therefore the passage through the coils of two equal currents would leave the relay inoperative.

The Polarized Relay.—This relay, as its name denotes, is supplied with a permanently magnetized armature. The one pole of this armature lies between the two poles of an electromagnet. When this magnetized armature moves decidedly in one direction or the other it is because the current in the electromagnet is flowing in a certain direction. The armature is polarized for the purpose of making the relay sensitive to changes in the direction of current. Changes in the strength of current have no effect upon it.

In the illustration two keys are shown. The first, A, as indicated, will have the effect of sending into the line the current of three cells of battery. The key, it will be further observed, has no control over the direction of the current. When it is moved down it operates the first relay C, a neutral relay of the type previously described. The current passing through the second polarized relay is ineffective because it lacks the direction required to throw the armature on the particular side which closes the contacts governing the local circuit and its sounder.



The Diplex, the Basis of the Quadruplex.

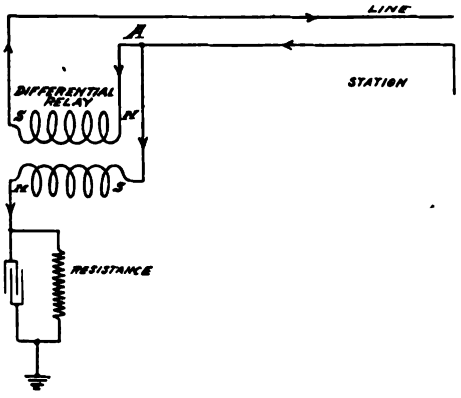
The second key, B, is a reversing key or pole-changing transmitter. Its only function is that of sending a relatively weak current into the line, which is either positive or negative, depending upon the position of the key. This weak current cannot affect the neutral relay which remains unresponsive to the currents passing through it unless sent by the first key A. The battery E and F will act in combination when key A is pressed, giving, therefore a much higher EMF. to the relay C than to D. When the key B is pressed to operate the relay D only one cell of battery F is in action. Relay C is evidently controlled by a rather powerful current sent into the line by the key A. Relay D is controlled by the second key B which, sending a weaker current into the line, still varies its polarity with reference to the line and therefore actuates the more delicately adjusted relay previously mentioned. Each relay, it must be remembered, is attached to a separate local circuit containing battery and sounder. Therefore, if one operator presses key A, a distant sounder in circuit with relay C gives its message. If another operator presses key B a distant sounder in circuit with relay D will deliver its message. This fact is to be distinctly remembered above all—that if both keys are worked simultaneously the direction of the current can be reversed at will by the operator at B. As this is the only influence which effects the polarized relay at D the system as thus presented is one in which two messages can be sent forward along the line at the same instant. This is the fundamental principle of the diplex system. Examination of key B will show that if the operator at A is holding his key and the operator at B reverses the current to actuate the relay at D the continuity of the line is not destroyed, but the relay C will relax for an instant, causing what is familiarly known as the *clip*. This is almost eradicated by the aid of special devices in practical telegraphy.

The Single Current Duplex.—In this system of telegraphy it is possible to send two messages over the line, each traveling in the opposite direction. It possesses certain essential and characteristic features which might be enumerated as follows:

First—A differentially wound relay.
Second—An artificial line.
Third—A transmitter.

The prevailing intention in this system, is to be able to send a message out of the station without affecting the relay installed there, yet permitting it to respond to the influence of a message or signal sent in. This seemingly difficult and paradoxical task, is accomplished by the proper co-operation and relationship of the three ideas presented above in conjunction with a storage battery.

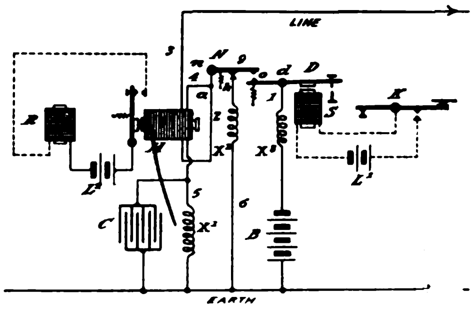
The Differential Relay being an electromagnet with two opposite and equal windings magnetically cannot be affected if each winding carries an equal current. If, therefore, when a signal is sent out of the station, the current it represents passes through this differential relay, then the problem resolves itself down to that of securing an equal flow of electricity through each of the windings of the relay. If means are employed, through which one-half of this current goes out over the line, and the other half is directed into the earth, then the difficulty has been removed and the object of keeping the relay inoperative under these circumstances secured.



Principle of Duplex, showing use af the Differential Relay and Artificial Line.

The Artificial Line now comes into play, in that it consists of a resistance equal to that of the line, and a condenser of a capacity also equal to that of the line. The current from the station is led to the point at which the two windings of the electromagnet begins, as shown in the sketch at A. If resistance R and the capacity C, are exactly equal to that of the line, then the current will divide equally at A. One-half will go through its winding and over the line. The other half will go through its winding into the earth. The currents being equal in each winding of the relay, it will remain unaffected when an outgoing signal is sent.

The Transmitter.—This device is employed in duplex telegraphy so that when the key is pressed, as shown in the sketch, the magnet S will pull the lever D, and raise the lever N at O. This enables the current from the battery B to pass into the differential relay, one-half to the line from n, and one-half to the earth from n. If at this moment, the distant telegrapher presses his key, then one of the coils of the differential relay will be supplied with more current than the other, and as a natural consequence of this, the relay will be operated. Its operation means the throwing in of the local circuit, and as a result the click of the sounder is heard. Examination of the diagram will show that the two ideas are faithfully carried out:



Single Current Duplex.

First—That of having the relay inoperative by an outgoing signal.

Second—That of having the relay operative by an incoming signal.

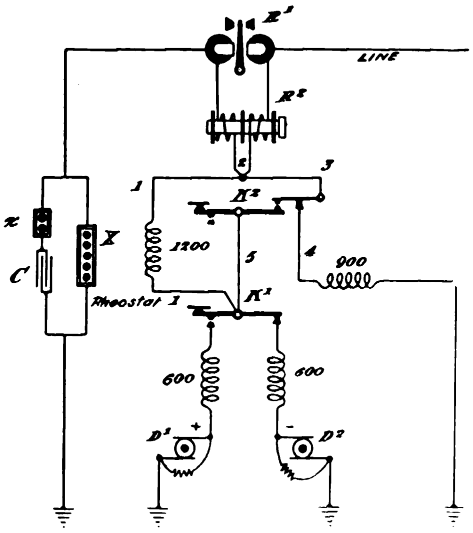
Examination of the Circuit.—Scanning the circuit closely will show the path of the different currents. When the key K is pressed, as already described, a negative current passes from the battery B through the levers D and N into the differential relay only to divide equally into the line and earth via the the two opposite windings of the relay. A signal sent in, however, means a current in only one winding of the relay, which of course will force it to operate, or it means a current superposed upon the other already passing through. This last condition only exists when both keys are pressed in each station at the same time. In the sketch, the wire grounded at 6, is there for the purpose of allowing an incoming current, whether positive or negative, depending only upon the arrangement of the batteries, after magnetizing the relay, to pass into the earth, otherwise two other paths are open through the resistance of the artificial line and the batteries B. The diplex and the duplex therefore differ from each other fundamentally in the respect that in the first case both the direction and the strength of the current are controlled to operate two relays adjusted to them; while in the second case, messages are transmitted in opposite directions, by having a relay in action sensitive only to the incoming impulse, remaining unaffected by the outgoing signals through the influence of the artificial line.

Purpose of the Condenser.—The introduction of the condenser in duplex telegraphy emanated from the brain of Joseph B. Stearns, who thus, by its practical application, removed from the apparatus the false signal its absence produces. The resistance of the artificial line and line proper may be the same; but it is obvious that if the line must be charged when signaling it is bound to discharge itself and affect the service. The line will act as a condenser with respect to earth, the line being one plate, the air the dielectric, the earth the other plate. Charging the line to get a signal through it would mean its subsequent discharge through the instruments. This now happens to an exaggerated degree in ocean cables. Duplexing a line, by adding an artificial line, consisting of resistance and capacity, is accomplished by the adjustment of these elements until the line is "balanced." Then the signaling is carried on from either end with the utmost facility. Adjustments of resistance and capacity must be carried on every day, particularly if the weather is changeable. Measurements will show that both the resistance and the capacity undergo continued and at times erratic variations.

The system of diplex, above described, is covered by the invention made in 1873 by Thomas A. Edison, patent No. 162,633. This system is in all respects the foundation of the present practical method of quadruplexing a line.

Quadruplexing a Line.—By this is meant the installation of apparatus, by means of which two messages can be sent from each end at the same time. Altogether, four different signals traverse the wire at one time without interference. The accomplishment of this, it is evident, would mean the use of two relays at each of the distant stations receiving signals. It it also obvious that when two signals are sent simultaneously from one station the relays of said station must not be actuated by the current. This idea is carried out in practice by the use of two differential relays at each station. These relays are respectively neutral and polarized, and operate in conjunction with an artificial line. In addition each station is provided with two keys of the characters previously described. One is used for sending a comparatively powerful current into the line, the other for reversing the polarity of the line. From this brief review it becomes apparent that this quadruplex is, in fact, a combination of duplex and diplex telegraphy.

In the illustration the quadruplex is shown operated by means of currents generated by dynamos D_1 and D_2. These take the place of batteries, and have proven themselves to be far more convenient. At D_1 and D_2 opposite poles are connected to the line when the two 600 ohm shunts are in curcuit. The description referring to this diagram, as given by Franklin Leonard Pope in his work entitled "Modern Practice of the Electric Telegraph" is as follows: "K_1 is the pole changing transmitter and K_2, the single current transmitter, which for simplicity are shown in the diagram as keys, but which are in practice operated by electro-magnets, local batteries and independent keys. When the apparatus is at rest, the current from the negative dynamo D_2 traverses a resistance coil of say 600 ohms, inserted to avoid danger of short circuit, to the rear contact of the pole changing key K_1; thence through wire 1, the 1,200 ohms to point 2, where it divides into three portions; the first portion going to the line and distant station, the second through the artificial line, including rheostat X to the earth, and the third through the wire 3, the normally closed rear contact of the single current key K_2 and a rheostat of say 900 ohms to the earth. If, for example, therefore, we assume the resistance of the main and artificial line to be 3,600 ohms each it follows from the law of the distribution of currents in branch circuits that two-thirds will return to earth through wires 3 and 4, one-sixth will go to the main line and one-sixth to the artificial line.



Quadruplex Operated by Dynamo Currents.

"If now the key K_2 be depressed in order to send a signal, a direct connection will be formed between key K_1 and the point 2 through wires 5 and 3, shunting the 1,200 ohm coil in wire 1. At the same time the wire 4 will be opened, and the whole current will divide at the point 2, half going to the main line and half to the artificial line. It follows, therefore, that with the several resistances in the ratios shown, the current sent to line by the key K_1 when key K_2 is depressed will be three times as strong as when the latter is raised, and this will be equally true whether the current sent by key K_1 be positive or negative. A computation of the effects of the several resistances will also show that when an arriving current reaches the point 2, the resistance which it has to encounter in passing thence to the ground is the same whether the key K_2 be depressed or raised. When the key is depressed the resistance is only that of one or the other of the 600 ohm coils between the key K_1 and the dynamos; when raised, it is the joint resistance of one coil of 600, plus the coil of 1,200 (a total of 1,800) in one branch and the coil of 900 in the other branch, the joint resistance of the two being 600, the same as in the first instance. The relays R_1 and R_2 at each station being both differential are not affected by outgoing currents, whatever may be the strength or the polarity of such currents."

* * *

NOTES ON THE CARE AND MANAGEMENT OF DYNAMOS.*

BY W. J. H.

A most important element in the efficiency of dynamos and motors, and one which makes considerable difference to their lifetime, is the care with which they are treated, and the immediate remedy of any fault or irregularity that may appear in them. It requires a certain amount of experience to be able to detect these faults and irregularities as soon as they occur, and also to know the proper steps to be taken to correct them before the damage becomes at all serious or has time to deteriorate the machine.

In many cases a breakdown or failure in a dynamo may be traced to negligence or carelessness pure and simple. Dynamo machinery cannot withstand ill-usage and overloading, although motors generally increase their output in proportion to the demand made upon them until a certain limit. If intelligence and common sense are used, a capable engineer should have no difficulty in looking after an electrical plant, and in keeping it up to its standard of efficiency by a system of regular running, cleanliness and general care. Of course, the treatment of dynamos in general applies to motors also. A most important point to be noticed is the temperature to which a dynamo attains after a few hours' run; good modern machines rarely increase in temperature more than 40 degs. to 45 degs. Fahr. above the surrounding temperature of the room in which they are running, after a run of many hours on full load. The parts that are seriously affected by a temperature rise are, of course, the armature and field coils, and any temperature under 130 degs. Fahr. is quite harmless to the insulation of these.

Care should be taken that the dynamo is quite rigid on its foundation, and no vibration whatever should be permitted to take place when the dynamo is running. This point should always be kept in mind by the attendant, who should make it his place to tighten up all loose bolts and bearings as soon as any tendency to looseness is apparent. In setting the brushes on the commutator, the points should always be placed diametrically opposite each other, resting very lightly on the commutator. They will probably need moving forward occasionally to maintain this position, and if it is noticed that the points become ragged or rough and uneven, they should be trimmed with a file or scissors.

It is most important that continuous-current machines should be free from sparking at full load. There should be a system of continuous lubrication, and all bearings should run cool. The most satisfactory lubricant to be used for the commutator is vaseline, which should be used sparingly, and wiped carefully off with a non-fibrous rag, in order to leave the least possible amount of lubricant to insure satisfactory results. If the brushes are made of alloy sheets, lubricating the commutator is not often necessary, as they give excellent results without. It sometimes happens that from inattention or structural faults, that the surface of the commutator becomes grooved and uneven; the armature should be taken out and turned up lightly in a lathe. With moderate attention the commutator should soon assume a fine dark polish.

When grit or dust gets into the bearings, they should be cleaned by means of thin oil poured into them, which will wash out the dirt. The importance of a perfectly true "run" cannot be overestimated, and a crooked belt which slides from one side of the pulley to the other is sure to give trouble sooner or later. The joint in a belt should be as smooth and as near the size and shape of the rest of the belt as possible, as the damage done to a dynamo with a belt which "knocks" as it passes over the pulley is incalculable.

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*From the "Electrical Engineer," London.

In order to run in a satisfactory condition the dynamo should make as little noise as possible. One of the first signs of looseness of bolts or vibration is a loud noise, which means that the dynamo is wearing in some part and needs tightening down, or else it is attributable to loose bearings, or armature or pulley out of balance.

It is frequently the habit of an inexperienced attendant to replace a blown fuse with one of greater capacity, thus inducing overload to the dynamo. Automatic cut-outs are used largely recently, which prevent this occurrence. A dynamo may refuse to start if the contacts be loose or bad, or if a circuit be broken and the residual magnetism be diminished. When a motor fails to start or stops, the cause may be a break in the circuit, bad contact or loss of magnetism or overload.

When handling a dynamo when working the attendant should always see that his hands are dry, and if anything goes wrong he should preserve his equanimity, and keep cool, as presence of mind can often avert catastrophe.

Civil Engineers to Improve Home.

Plans have been filed with the New York Building Department for the enlargement of the Society House of the American Society of Civil Engineers, the organization that declined to affiliate with other societies in accepting Mr. Andrew Carnegie's recent gift of a $1,350,000 club house and technical building. The house is a four-story edifice at 222 West 57th street, and it is proposed to add a four-story annex which will give the building a total frontage of 75 feet. The second story will contain the library and a large auditorium. The improvements will cost $60,000.

Judge Townsend in New York on Saturday granted the motion of counsel for the American De Forest Wireless Telegraph Company, suspending the injunction the court had recently granted in favor of the Marconi Wireless Telegraph Company pending final hearing of the case.

NATIONAL ELECTRIC LIGHT CONVENTION.

OFFICIAL PROGRAMME AND TRANSPORTATION INFORMATION.

The 28th Convention of the National Electric Light Association will be held at Brown Palace Hotel, Denver, Col., June 6, 7 and 8, and at Colorado Springs June 9, 10 and 11.

The official programme, information about transportation and other notes of interest will be found in the following:

HEADQUARTERS.

The headquarters of the association will be at Brown Palace Hotel. This hotel will not accommodate all the delegates but there are a number of other first-class hotels in the immediate vicinity, where the hotel committee will place those making application too late for the rooms at the Brown. Reservations should be made through Mr. Frank Farrar, committee's secretary, 405 17th street, Denver. Full information regarding hotel arrangements has already been sent out by the committee.

ENTERTAINMENT.

The entertainment of delegates will include a theater party at the Elitch Summer Gardens, a luncheon at the Denver Country Club for the ladies, followed by a drive about the city. The ladies will also be entertained at the Orpheum Theater during an evening session of the convention, and after this session the men will be entertained at a smoker.

One afternoon will be devoted to a Broncho Busting contest. Great care has been taken in selecting for this typical Western exhibition the best horses and men to be found in Wyoming, Colorado and Mexico.

On Friday morning the entire party will be taken to Colorado Springs on special trains. During Friday afternoon there will be drives to points of interest about Colorado Springs, Glen Eyrie, Garden of the Gods, Cheyenne Canons, over the Bear Creek Canon road to Bruin's Inn; also visits to the power plants of the Colorado Springs Interurban Railway Company, the Colorado Springs Electric Company, the Curtis Company's lignite coal mines, the reduction mills at Colorado City, the Pike's Peak Hydro-Electric Company's hydraulic plant at Manitou, from which point the delegates may take the "Cog Road" to Pike's Peak. In the evening there will be a concert at the Broadmoor Casino.

Saturday will be given to an all-day trip to Cripple Creek, through the most beautiful scenery in Colorado.

On Sunday such of the delegates as desire to do so will have an opportunity to take trips mentioned for Friday afternoon, as it will be impossible for all these trips to be taken in one day.

TRANSPORTATION.

Unusually low rates have been authorized by the respective railways to Denver-Colorado Springs meeting. From all points in the Western Passenger Association territory a rate of one fare plus 50 cents for the round trip has been granted, this to apply only where one-way rate is $12 or more.

The Trans-Continental Passenger Association has authorized a rate from California to Denver and return of one fare. The New England Passenger Association and Trunk Line Association have authorized a rate of a fare and one-third from the respective points in their territory to Chicago and St. Louis plus the rates authorized by Western Passenger Association, namely, $30, Chicago to Denver and return.

Other associations will probably make similar concessions, but no official notice has yet been received. Ask your ticket agent when buying your ticket, regarding special rates for this convention.

Arrangements have been completed for a special train of Pullman sleeping, dining, parlor, smoker and observation cars, via Pennsylvania and Burlington Railways, leaving New York at 10:25 A.M. Saturday, June 3, and running as the second section of the Limited, for the convention. The train will arrive at Chicago at 8:25 A. M. June 4, leave at 11:15 the same morning, and arrive at Denver at 2:30 P.M. June 5.

At Chicago the train will be consolidated with cars for the special party that is being made up at that point.

The fare from New York to Denver and return on this train will be $56.70. Sleeping car berth, New York to Denver, $11.

Applications for space on this train should be made to Mr. C. H. Hodskinson, 70 State street, Boston; Mr. Frank L. Perry, Marquette Building, Chicago, or to Mr. George F. Porter, 136 Liberty street, New York.

HOW TO PURCHASE TICKETS.

If you desire to travel via Burlington, Rock Island, or Union Pacific, buy tickets through Denver to Colorado Springs with stop-over privilege at Denver on the going trip.

If you desire to travel via the Santa Fe, Missouri Pacific, Denver & Rio Grande, Colorado Southern and Colorado Burlington, buy tickets through Colorado Springs to Denver with stop-over privilege at Colorado Springs on the return trip.

PROGRAMME.

TUESDAY, JUNE 6—FIRST SESSION, 10 A.M.

Convention Hall, Brown Palace Hotel.

Address of Welcome, the Mayor of Denver.

President's Address, Ernest H. Davis, Williamsport, Pa.

Report, Progress, T. Commerford Martin, New York.

The Paramount Importance of Choosing Standard in Preference to Special Machinery, David Hall, Cincinnati, O.

Insulation Testing—Apparatus and Methods, C. E. Skinner, Pittsburg, Pa.

TUESDAY, JUNE 6—SECOND SESSION, 2 P.M.

Automatic Synchronizing of Generators and Rotaries for Lighting and Power Systems, Paul MacGahan, Pittsburg, Pa.

Notes on Rotary Converters and Motor Generators for Lighting and Power Systems, Louis E. Bogen, Cincinnati, O.

The Organization of Working Forces in Large Power Houses, W. P. Hancock, Boston, Mass.

Report of Committee on Steam Turbines, W. C. L. Eglin, Chairman, Philadelphia, Pa.

Operating Features of the Curtis Steam Turbine, A. H. Kruesi, Schenectady, N. Y.

WEDNESDAY, JUNE 7—THIRD SESSION, 10 A.M.

Series Alternating Current Motors for Industrial Work, Clarence Renshaw, Pittsburg.

A New Type of Single-Phase Motors for Elevator Work, S. Percy Cole, St. Louis, Mo.

Long Distance High-Tension Transmission in California, John A. Britton, San Francisco.

Report, Present Methods of Protection from Lightning and other Static Disturbances, Alex Dow, Detroit, Mich.

The Nernst Lamp—Its Present Performance and Commercial Status, E. R. Roberts, Pittsburg.

The Choice of an Insulated Cable, Wallace S. Clark, Schenectady, N. Y.

WEDNESDAY, JUNE 7—FOURTH SESSION, 8 P.M.

Some Investigations of Induction Losses, E. P. Dillon, Colorado Springs, Col.

Mercury Arc Rectifiers, P. D. Wagoner, Schenectady, N. Y.

Report, Advertising Methods, Percy Ingalls, Newark, N. J.

Report, Sign and Decorative Lighting, Le Rue Vredenburgh, Boston, Mass.

Free Signs and Flat Rates, C. W. Lee, Newark, N. J.

THURSDAY, JUNE 8—FIFTH SESSION, 10 A.M.

Report, Progress of Electric Heating, James I. Ayer, Boston, Mass.

Report, Purchased Electric Power in Factories, E. W. Lloyd, Chicago.

Report, Committee on District Steam Heating, W. H. Blood, Jr., Chairman, Seattle, Wash.

Wrinkles, H. C. Abell, Editor, New York City.

THURSDAY, JUNE 8—SIXTH SESSION, 2 P.M.

Report, Committee on Relations with Kindred Organizations, James I. Ayer, Chairman, Boston.

Executive Session.

Report, Committee on Rates and Costs, Charles L. Edgar, Chairman, Boston.

Report, Municipal Ownership, Arthur Williams, New York City.

Question Box, Homer E. Niesz, Editor, Chicago.

THURSDAY, JUNE 8—SEVENTH SESSION 8 P.M.

Executive Session.

Report of Secretary and Treasurer.

Report of Executive Committee.

Report of Committee on Relations between Manufacturers and Central Station Companies, Henry L. Doherty, Chairman, Denver, Col.

Report of Committee on Standard Rules for Electrical Construction and Operation, Charles L. Edgar, Chairman.

Election of Officers.

Strange Telephone Situation in Indiana.

The Central Union Telephone Company, a licensee of the American Telephone & Telegraph Company, has entered into a working agreement with the United Telephone Company, an Independent Company, with the result that the latter company becomes a sub-lessee of the American Telephone & Telegraph Company.

President L. G. Richardson, of the Central Union Telephone Company, who is now in the East, says:

"The arrangement entered into between the Central Union and United Telephone Companies is one of the most important which has taken place in telephone circles in many years. The Central Union will lease the Bell instruments to the United Company, and as our company has no connections in the field occupied by the United Company, this arrangement practically gives us a new telephone field.

"The United Telephone Company has $480,000 bonds and $300,000 stock outstanding and its property is worth about $700,000. This company owns the exchanges and toll lines in Wells, Grant, Blackford and Huntington Counties in Indiana and has 5,000 subscribers.

"Under the new working agreement the United Company secures connection with the toll lines of the Central Union Telephone Company and those of the American Telephone & Telegraph Company. The United Company heretofore has been operated in connection with the Independent telephone companies in Indiana, but will now sever its affiliation with the Independents, and will be operated in connection with the Bell companies.

"The president of the United Company is Hugh Dougherty, president of the Marion Trust Company, Indianapolis."

ANNUAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

A large attendance was present last week at the annual meeting of the American Institute of Electrical Engineers, held in the chapter room of Carnegie Hall, this city.

The proxy tellers announced the result of the balloting for officers as follows: President, Dr. S. S. Wheeler; vice-presidents, C. A. Terry, T. Wolcott, Gano S. Dunn; managers, C. C. Chesney, Calvert Townley, Bancroft Gherardi, C. L. Edgar; treasurer, G. A. Hamilton; secretary, R. W. Pope. Dr. Wheeler received 1,031 votes, his election being almost entirely unanimous.

The reports of officers and committees were presented and accepted. The secretary reported that the membership on May 1 was 3,460.

The financial statement for April, 1905, shows that the cash on hand was $39,301.15, the value of the Institute properties was $44,220.11, making a total of $92,396.89.

Mr. Calvin W. Rice, chairman of the land and building fund committee, reported that this fund has reached the sum of $66,000, two of the recent contributions being $5,000 from Thomas A. Edison and $5,000 from Dr. M. I. Pupin, the latter being given under the condition that nine other members of the Institute give a similar amount.

The report of the board of examiners was read by the secretary. This suggests that the board of trustees consider establishing a new class of membership, to which associates who have become eminent in their particular field, but who are not practicing engineers, shall be eligible.

The Institute's Annual Convention.

The annual convention of the American Institute of Electrical Engineers will be held at Asheville, N. C., June 19 to 23. A long list of papers has been prepared for presentation to the convention. The committee on transportation and arrangements is Frederick C. Bates, chairman, 44 Broad street, New York City; Samuel Sheldon and Arthur Williams.

New York State Independent Telephone Convention.

The annual convention of the New York State Independent Telephone Association will be held at the Common Council Chamber, City Hall, Albany, June 16. A good programme has been prepared and from the present indications the attendance will be large. Some effiective work has been done throughout the State during the past year by the organization of district associations, which form a part of the State Association.

Further information relative to the convention can be secured by addressing the secretary, T. S. Lane, 332 Ellicott street, Buffalo, N. Y.

The Canadian Electrical Association Convention.

As already announced in ELECTRICITY the annual convention of the Canadian Electrical Association will be held in Montreal June 21, 22 and 23. Secretary Mortimer announces the following as some of the papers to be read:

"Transformers," by Mr. R. T. MacKeen, Toronto; "Operation of Transformers at Varying Frequencies and Voltages," by Mr. Sammett, Montreal; "Induction Motors," by Mr. Burson, Montreal; "Economy of Isolated Plants," by Mr. T. L. Aitken, Toronto; "Carrying Capacity of Inclosed Conductors," by Prof. R. B. Owens, McGill University.

Naval Stations Catch Wireless Messages.

The Bureau of Equipment at Washington continues to receive interesting reports from the operations of wireless telegraphy as conducted by the Navy afloat and ashore.

The Washington Navy Yard reports that the wireless station there caught a message passing between the Boston Navy Yard and the station on Thatcher's Island, off the New England coast.

The bureau also has been informed that a wireless news bulletin, which was being sent from Cape Cod seaward, was caught on the Cruiser Maryland, lying at dock at Newport News. In each instance the distance was several hundred miles.

Important Traction Deals.

A Portland, Ore., dispatch says the Portland Consolidated Street Railway Company, operating nearly all the street car lines in Portland, has been sold to a syndicate of Pennsylvania capitalists for $5,000,000.

A dispatch from Columbus, O., May 22, says the Ohio Traction Company of Cincinnati was incorporated under the laws of Ohio with a capital stock of $20,000,000, in accordance with a plan of the Widener-Elkins syndicate, recently announced. The incorporators are W. Kesley Schoepf, W. S. Rowe, W. C. Proctor, Briggs S. Cunningham and W. T. Irwin.

A New Insulator.

In a recent issue of the "Elektrotechnische Zeitschrift" there appears a description of a new insulating material known as Galalith. It is prepared from skim milk, by a process on the whole similar to that employed in the production of ebonite. The result is a material having a structure which also resembles that of ebonite or horn. Water is first removed from the skim milk, the resulting product being hardened and then treated with certain acids, the material thus obtained being plastic. It is next pressed by hydraulic power into definite shapes and it is finally treated in a drying stove. Galalith is said to be from about 28 to 30 per cent. more elastic than ebonite and is easily machined. Its density is about 1.4.

Proposals Invited.

Washington, D C.—The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until June 6 for furnishing Eastern navy yards with the following electrical material: Schedule 257, incandescent lamps, carbons, dry batteries, switches, wires, electrical supplies; schedule 258, starting panel; schedule 260, motors; schedule 262, motors; schedule 263, insulating tape. Proposal blanks and other information can be obtained upon application to the Navy Pay Office in New York.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MAY 16, 1905.

Electric Railways and Appliances.

789,702. Electric Signal System. Edwin J. Adams, Waco, Tex. Filed Feb. 13, 1904.

789,715. Pneumatic Trolley-Check. Andrew G. Cassidy, Waltham, Mass. Filed Nov. 5, 1904.

789,804. Trolley Catcher and Retriever. Walter W Geiser, Altoona, Pa. Filed Dec. 19, 1903.

790,024. Fender. Summers F. Beckwith, Charleston, W. Va. Filed Sept. 20, 1904.

790,107. Trolley. John H. Clark, Urichsville, O. Filed March 3, 1905.

Electric Lights and Appliances.

790,152. Incandescent-Lamp Socket. Guy H. Proctor, Somerville, Mass., assignor, by mesne assignments, to the Bryant Electric Company, Bridgeport, Conn. Filed May 10, 1904.

Electrical Machinery and Apparatus

789,727. Transmission-Gearing. Norman T. Harrington, Detroit, Mich., assignor to the Olds Motor Works, same place. Filed March 21, 1904.

789,754. Governor for Non-Automatic Electric-Motor Controllers. William J. Napier, Leichhardt, New South Wales, Australia. Filed Jan. 6, 1904.

789,914. Electric Switch. Frederick Huffer, New York City. Filed Oct. 31, 1904.

789,917. Machine for Grinding Commutators of Dynamos or Motors. William H. Jordan, Brooklyn, N.Y., assignor of three-fourths to John F. Jordan, George A. Jordan and Christopher C. Jordan, same place. Filed Aug. 20, 1904.

789,975. Electric Switch. Gustave L. Herz, New York City. Filed Oct. 7, 1904.

790,100. Safety Device for Motor-Starters. Frederick G. Bill, Long Island City, N. Y., assignor of one-half to Francis H. Murphy, New York City. Filed Feb. 21, 1905.

790,155. Electric Time-Switch. Jerome Redding, Boston, Mass., assignor to the Redding Automatic Time Switch Company, same place. Filed May 21, 1904.

790,258. Alternating-Current Meter. Albin May, Berlin, Germany, assignor to the Internationale-Elektrizitäts-Zahler, Gesellschaft, M. B. H., same place. Filed July 29, 1903.

790,262. Indicating-Dial for Electric Switches. Charles G. Perkins and Nathan W. Crandall, Hartford, Conn., assignors, by mesne assignments, to the Perkins Corporation, same place.. Filed Oct. 19, 1904.

Telephones and Telephone Apparatus.

789,716. Telephone-Transmitter. Henry P. Clausen, Chicago, Ill., assignor to the American Electric Telephone Company. Filed Aug. 20, 1902. Renewed April 6, 1905.

789,748. Code-Signaling Telephone. Charles T. Mason, Sumter, S. C., assignor to the Sumter Telephone Manufacturing Company. Filed Feb. 11, 1905.

789,925. Coin-Controlled Telephone System. Charles W. Mahon, Chicago, Ill. Filed Sept. 6, 1904.

789,985. Telephone Cut-off. Herbert Manring, Weatherby, Mo. Filed July 14 1902. Renewed Feb. 14, 1905.

790,103. Combined Annunciator and Jack for Telephones. Daniel W. Campbell, La Crosse, Wis., assignor to the Vought-Berger Company, same place. Filed July 25, 1903.

790,241. Antiseptic Mouthpiece for Telephones or the Like. Walter Wright, San Francisco, Cal. Filed May 12, 1904. Renewed April 21, 1905.

Miscellaneous.

789,721. Electrolytic Apparatus. Frank A. Decker, Philadelphia, Pa., assignor to the Decker Manufacturing Company, Wilmington, Del. Filed Feb. 29, 1904.

789,740. Electrolytic Apparatus. Woolsey M. Johnson, Iola, Kan. Filed Aug. 14, 1903.

789,769. Relay. Jesse Summers, Indianapolis, Ind., assignor to the Indianapolis Watchman Clock Company. Filed July 5, 1904.

789,778. Signaling System. Joseph A. Wilson, Westfield, N. J., assignor to the Hall Signal Company. Filed Sept. 13, 1904.

789,814. Interrupter. Maurice K. McGrath, Antwerp, Belgium, assignor to the Western Electric Company, Chicago, Ill. Filed Oct. 21, 1904.

789,822. Automatic Electric-Current Regulator. Thomas A. Swarts, Columbus, Ohio. Filed Feb. 29, 1904.

789,877. Relief-Valve for Storage Batteries. David P. Perry, Chicago, Ill., assignor to the Vesta Storage Battery Company. Filed May 22, 1903.

789,886. Lightning Arrester. Guy H. Short, Stillwell, Ill. Filed Aug. 1, 1904.

790,095. Electric Signaling System. Samuel M. Young and Fitzhugh Townsend, New York City. Filed Oct. 18, 1904.

790,179. Wireless Telegraphy. Ferdinand Braun, Strassburg Germany. Filed Nov. 4, 1904.

790,189. Electric Alarm System. Hippolyte M. Cooper, Coopers Plains, N. Y. Filed Oct. 15, 1904.

790,193. Telegraphy. Patrick B. Delaney, South Orange, N. J. Filed June 30, 1902.

790,226. Electrical Furnace. Isedore S. Prenner, Scranton, Pa., assignor of one-half to Gus. N. Brown, Scranton, Pa. Filed March 21, 1903.

THE TELEPHONE WORLD.

Independent Telephone Men Meet in Texas.

At the recent meeting of the Independent Telephone Association in Dallas. the principal business was the reports of different committees that had been appointed, the discussion of their reports and matters of interest in regard to the welfare of the Independent companies in the State were discussed. A large number of representatives of supply houses were on hand and were admitted to the meeting as delegates.

The applicants desire to construct a line between Dallas and Fort Worth, which they claim will give all Independent lines and exchanges connection at Dallas.

It is believed that the purpose of the meeting in Dallas at this time is to encourage the council in granting the application of the Texas Long Distance Telephone Company for a franchise into Dallas. After much discussion of the matter of securing a franchise at this meeting, a committee composed of F. B. McElroy and A A. Miller, of Dallas, and James Murray, of Fort Worth, was appointed to take the matter up.

Frontier Company Elects Officers.

At a recent meeting of directors of the Frontier Telephone Company held in Buffalo, N. Y. B. G. Hubbell, president of the Consolidated Telephone Company, was elected president and director of the Frontier Company, and H. H. Persons, former president, was elected first vice-president.

This change was agreed upon at the time of the Consolidated Telephone Company's purchase of the control of the Frontier Company, and follows the plan of the company in having its president elected president of all the subsidiary companies. Mr. Hubbell is a practical telephone man, who has made great success in his operations of the many telephone properties owned by the Consolidated Telephone Company, and great things are predicted for him in his management of the Frontier Company.

Other directors elected were R. R. Hefford, F. C. M. Lautz and Robert W. Chapin, who filled vacancies caused by resignations of out-of-town directors.

Judge Robert E. Umbel, John M. Core and Robert F. Hopwood, the executive committee of the Tri-State Telephone Company, have effected a deal in Uniontown, Pa., whereby the Tri-State Company became the owner of the Monongahela Valley Telephone Company, which is composed mostly of Brownsville capitalists.

The Miller, S. D., city council has granted Waite & Halbower a franchise to build a telephone line into that city. The purpose is to build a line to the country districts.

Claude Eaton, who in partnership with Fred Scoresdy, has bought the Sterling, Kan., telephone exchange, and says they are preparing to put in a greatly improved service in that city.

It is announced that $25,000 improvements to the Co-operative telephone line of Detroit, Mich., will be completed in from four to six weeks.

Independent Telephone Merger in Nebraska.

The Independent telephone companies in Northeast Kansas, Northwest Missouri, Southwest Iowa and Southeast Nebraska, have consolidated into one company. The new company will control all the Independent telephone lines between Kansas City, Omaha, Lincoln, Red Oak and all intermediate cities and towns. Bonds to the amount of over $500,000 will be issued. The promoters of the consolidation acknowledge that a merger has been agreed upon, but refuse to give out any of the particulars.

Telephone Merger Planned.

The consolidation of all the important telephone lines of the Peninsula and their merger into the Diamond State Telephone Company of Dover, Del., is being planned. The companies included are the Maryland and Delaware Telegraph & Telephone Company, of Wicomico County; Eastern Shore Telegraph & Telephone Company of Caroline County; Onancock Telephone Company, Peninsula Telephone Company, and the Atlantic Telephone Company, of Virginia. The Onancock, Atlantic and Peninsula Companies, all Virginia concerns, will shortly have meetings of their stockholders, when a decision will be reached by them in regard to their action in this matter. The Eastern Shore and the Maryland and Delaware Companies will have meetings early in June for the same purpose.

C. C. Curtis, manager of the Independent telephone exchange at Sandusky, O , will become manager of the Southern Ohio district for the United States Telephone Company May 27. The field has been included in other districts, but recently a division was made, and Mr. Curtis will have charge of nearly all territory south of Youngstown and Lima, with the exception of Dayton and Columbus, and the counties surrounding these cities.

The Pleasantdale Telephone Company is the second Independent concern to incorporate in Pleasantdale, Neb., recently. The capital stock is given at $10,000, and the incorporators are W. Cody, C. H. Oxley, E. Courtright, F. C. Finke, H. C. Finke, L. Finke and C. Mason.

The toll rate on the long-distance line of the Delaware & Atlantic Telegraph & Telephone Company from Wilmington, Del., to Baltimore, Md., has been reduced from 50 to 35 cents for a three-minute talk, the night rate being 25 cents.

The directors of the Smith County Telephone Company recently met in Taylorsville, Miss., and arranged to put in an exchange there and at Raleigh. The line is in operation from Taylorsville to Raleigh via Hissop and Bezer.

The Home Telephone Company, which secured a franchise from Meridian, Miss., several months ago, has begun work with a large force of men putting its wires underground.

The Cambridge, Me., Telephone Company will extend its line to Parkman and Webber, this summer.

Telephone Manufacturing Company to Dissolve.

Proceedings for the dissolution of the Maryland Telephone Manufacturing Company, of Baltimore, were instituted by the company in Circuit Court No. 2 about 10 days ago through Marbury & Gosnell, attorneys.

The company was incorporated March 2, 1898, with an authorized capital stock of $25,000. Up to February 7, 1904, it was engaged in the manufacture of telephone equipment, but the great fire destroyed its plant, property and everything connected with the business.

In order to start business again an entirely new plant would have to be purchased, but because of the great competition at this time, it was deemed beneficial for the interests of the stockholders and others to dissolve the company. The dissolution was determined upon at a meeting of the directors March 27 and at a general meeting of the stockholders May 1.

The company has cash assets of $25,079.58 and no debts.

An order signed by Judge Dennis requires cause to be shown by June 12 why the company should not be dissolved, if any such cause exists

Berlin's Telephone System.

According to a recent report, Berlin possesses a network of telephones which now numbers 86,000 apparatus actually in use. The telephone department divides the system of connections into several sections. No. 1 alone has 13,538 subscribers, while No. 4 comes in a good second with 12,884.

The annual meeting of the Schenectady, N. Y., Home Telephone Company was held recently and the directors were re-elected as formerly with the exception of J. F. Deems and E. E. Williams, who are succeeded by Homer Strong and J. W. Smitley. The officers elected for the ensuing year by the directors are Charles F. Veeder, president; Irving H. Griswold, vice-president; Sam M. Strong, secretary; Evans S. Kellogg, treasurer. A large amount of new cable work was authorized and will be installed at once to accommodate the growing list of subscriptions.

The annual meeting of the stockholders of the Red Jacket Telephone Company, of Manchester, N. Y., was held lately, and the following officers were elected: President, Carlos P. Osgood; vice-president, Robert B. Peck; secretary, Willis C, Ellis; treasurer, Oliver S. Titus.

The Stark County Telephone Company, of Toulon, Ill., has increased its capital stock from $6,000 to $20,000.

Telephone Incorporations.

The Home Telephone Company, Oneonta, N. Y. Capital stock, $50,000. Directors: W. B. Brown, A. W. Cutler and M. G. Keenan, all of Oneonta.

The Champlain Valley Telephone Company, Portland, Me. Capital stock, $150,000. Officers: President, F. W. Story, Boston; treasurer, C. H. Adams, Portland; clerk, Frederick Hale, Portland.

The Ne-ah-ga Telephone Company, Sterling, N. Y. Capital stock, $1,500. Directors: J. R. Ingersoll, W. R. Andrews. L. S. Frolick, all of Sterling.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Albany, N. Y.—The Empire Transmission Company has been organized to deal in electricity for light, heat and power. Its capital stock is $25,000, and incorporators, John P. Brooks, William J. Hough, Albany, and Joseph A. Lawson.

Alden, Ia.—On May 29 the people of this place will vote on the question of granting the Peterson Heat, Light & Water Company, of Des Moines, an electric light franchise. There is no opposition to the proposition, and it is generally conceded it will be carried almost unanimously.

Blasdell, N. Y.—The Blasdell Electric Company has been formed to supply electricity for light, heat and power. Its capital stock is $50,000, and directors, J. B. Wall, M. M. Wall and T. H. Wall, all of Buffalo.

Bloomsburg, Pa.—The Berwick Electric Light Company will soon improve its plant on Pine street.

Bristol, Vt.—The electric light plant here is to be thoroughly overhauled and put in first-class condition. E. D. Blackwell, of Brandon, is now interested in the company.

Chatham, N. Y.—The Lindenwald Light, Heat & Power Company, recently incorporated, will supply gas and electricity. The company is capitalized at $25,000. The directors are A. B. Gardenier, S. W. Smith and M. P. H. Smith, all of this place.

Fall River, Mass.—The stockholders of the Fall River Electric Lighting Company have increased its capital from $350,000 to $600,000.

Flora, Ind.—Dr. Ross is preparing to build and operate an electric lighting plant here.

Hagerstown, Md.—The street commissioners of this city will enlarge the municipal electric light plant.

Hailey, Ida.—The Cramer Electric Light Company has been incorporated with a capital of $50,000 by Leo Cramer, John R. Hart and others, of Salt Lake City, Utah.

Halesite, N. Y.—The plant of the Huntington Light & Power Company, at this place, in which many Brooklyn men are interested, is to be enlarged.

Hawley, Pa.—The plant of the Electric Light Company was almost completely destroyed by fire. The loss is estimated at about $15,000.

Hempstead, N. Y.—The town board recently granted the Queens Borough Gas & Electric Light Company the right to extend its poles and wires to almost every section of the township and without reimbursement to the town.

Kirkwood, Ill.—The Kirkwood Electric Light Company has been incorporated with a capital of $12,000 by J. F. White, J. K. Kyler and R. W Houston.

Lake Charles, La.—The city council has ordered an election to decide whether bonds shall be issued to build a new $60,000 municipal electric lighting plant.

Mansfield, Ill.—The trustees of this village have decided to buy the electric light plant recently erected here. The consideration is $7,000.

Monmouth, Ill.—The Monmouth Gas & Electric Light Company of this city, will make a great many improvements in its plant this summer.

Nantucket, Mass.—Buxton & Coleman have received the contract to reconstruct the plant of the Citizens' Gas & Electric Company here.

Odin, Ill.—The citizens held a meeting recently, and indorsed the action of the town board in regard to lighting this village by electricity, the power for lighting to be furnished by the Odin Coal Company. Work will begin as soon as possible.

Paris, Ill.—The electric light committee has been instructed by the council to secure estimates of cost of enlarging the light plant.

Prairie Grove, Ark.—The city council has granted a franchise to C. L. Cummings, for an electric light plant.

Richmond, Va.—E. W. Trafford will report to the special joint committee on the question of erecting an electric light plant for this city. It is thought that the plant will cost about $400,000.

Rock Island, Ill.—It is reported that the village trustees are contemplating installing an electric light plant.

Sayville, N. Y.—The Sayville Electric Light Company held its annual meeting last week when the following officers were re-elected: D. D. White, president; I. H. Green, vice-president; J. A. Nauert, secretary, and Charles N. Aldrich, treasurer. A semi-annual dividend of 3 per cent was declared.

Shreveport, La.—The city council has adopted a resolution ordering an election May 25 to decide the question of municipal ownership of the electric light plant.

South Paris, Me.—Charles S. Humphries, of Madison, a member of the firm of Cook & Humphries, civil engineers, Boston, has been here investigating the different available water powers in view of locating an electric light plant to light this village.

St. Augustine, Fla.—The city council will grant a franchise to an electric light company for the purpose of giving light, heat and power to this city.

Tifton, Ga.—Norman Park will soon be lighted by electricity. A $2,500 plant will be installed within a few weeks.

Wisner, Neb.—The recent special election on the question of issuing $9,000 in bonds for the erection of a lighting system for this village resulted in a victory for bonds.

STREET RAILWAYS.

Columbus, O.—The Wilmington, Jamestown & South Solon Electric Railway Company was incorporated with a capital of $10,000. A. J. Wilson, B. F. Patterson and others are interested.

Frederick, Md.—James H. Ingram, Jr., is interested in the building of the proposed trolley road from here to Baltimore, and says that work will be commenced soon.

Gainesville, Tex.—The Gainesville Electric Railway & Light Company, capitalized at $50,000, will operate street electric railways, interurbans and an electric light and power plant. The incorporators are Edward J. O'Bierne, W. L. Greenhill and others.

Grand Forks, N. D.—S. W. Wheeler, of the Wheeler Land Company, is at work interesting Eastern capital in an electric railway to run from this city to Crookston.

Howell, Mich.—This village has granted a franchise to James and Charles Van Keuren and others, for an electric line from Lansing to Detroit.

Kalamazoo, Mich.—If the proposed electric road between this city and Niles becomes a reality, electric travel between Detroit, and Chicago will follow quickly.

Manistique, Mich.—An electric line between here and Garden will be constructed soon.

Mound City, Kan.—The first survey for an electric line through Linn County has just been finished. The line will run north through a territory not pierced by railroads.

Oceanic, N. J.—The Monmouth County Electric Company is arranging for the extension of its tracks from Red Bank to this place.

Owosso, Mich.—J. W. Thick and O. D. Cooper, of Detroit, have been here looking up the electric railroad situation. They propose to build a line from Pontiac to this city, and thence to Chesaning and Saginaw.

Selma, Ala.—An electric line will be built from here to Marion.

Shepherd, Mich.—The proposed electric road between Grand Rapids and Bay City is likely to touch this place. Col. W. W. Boynton, the promoter, has been in this section in the interests of the scheme and is satisfied that the enthusiasm with which the matter is being received will insure the road for this section. It is now proposed to make Shepherd a distributing point, and a bonus of $5,000 is asked.

Staunton, Va.—A charter has been granted to the Virginia Valley Traction Company with its principal office in this city. H. B. Sproul is president and H. G. McGary secretary.

Utica, N. Y.—W. K. Vanderbilt, Jr., is to become actively interested in the trolley properties in which the New York Central & Hudson River Railroad Company has recently acquired part ownership. It is his purpose to become interested in the development of the trolley system in the Mohawk Valley. He has taken up the matter of electrifying the West Shore between this city and Syracuse.

POWER PLANTS.

Buffalo. N. Y.—The Western Counties Transmission Company has been incorporated with a capital stock of $2,000,000. The directors are: Robert W. Pomeroy, Joseph G. Dudley, Harold G. Meadows, H. T. Ramsdell, Charles G. L. Gurney, Robert W. Chapin and Louis B Hart. all of this city. The company is formed to transmit electric power throughout 25 western counties of this State.

Queretaro, Mex.—This city will this fall install a new hydro-electric power plant to cost over $600,000. The president of the company owning the plant is Francisco G. de Cosio, the goveror of the State, and the manager and principal owner is Ramon Bueno.

BIDS WANTED.

Washington, D. C.—On June 20 the Bureau of Supplies and Accounts of the Navy Department will open bids for furnishing the Mare Island and Puget Sound, Wash., Navy Yards, with the following: Schedule 267, incandescent and arc lamps, carbons, tape; schedule 268, incandescent lamps, insulating rings. Blank forms of proposal can be obtained upon application to the Bureau.

NCTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15@15⅛c.; Lake 15@15⅛c.; casting, 14¾@14⅞c.

Plans are on foot for the reorganization of the Appleyard electric lines.

There are rumors of a forthcoming assessment on Philadelphia Rapid Transit.

Press agents of the Westinghouse Electric Company are talking of a 12 per cent. dividend this year. There was a break of 10 points in the stock on Friday.

Directors of the Philadelphia Electric Company have declared the usual semi-annual dividend of 2½ per cent., payable June 15 to stock of record May 24.

Frank Jacobs, of Allentown, Pa., has been appointed as master to sell the Allentown & Slatington Electric Railway under foreclosure proceedings. The price has been fixed at $275,000, bidders to deposit certified checks for $10,000.

The annual report of the Potomac Electric Power Company of Washington, D. C., shows gross earnings of $723,773, an increase of $79,021 over the previous year. The net earnings amount to $423,514 and the surplus over fixed charges is $283,142.

It is understood that the National Carbon Company directors will meet during the first week in June to consider the matter of further dividends on the common stock. There is talk of another disbursement of 1½ per cent., the same as was made in January last. This would put the stock on a 3 per cent basis.

The first statement of the Sprague Electric Company of New Jersey, which is controlled by the General Electric Company, was recently made public and is as follows: Assets, real estate, $286,809; machinery, $108,283; merchandise and stock in process, $360,167; cash and debts receivable, $439,767; patents, $1; total, $1,195,028; liabilities, capital stock, $1,000,000; accounts payable; $45,305; surplus, $149,723; total, $1,195,028.

Spencer Trask & Co. of New York are offering to investors the 6 per cent. preferred stock of the Milwaukee (Wis.) Electric Railway & Light Company at a price to net about 5 per cent. income. The par value of the stock is $100, dividends being payable quarterly. The issue is absolutely limited to the $4,500,000 now outstanding and is followed by an outstanding issue of $9,000,000 common stock, upon which 5 per cent. dividends are paid.

Application has been made to the New York Stock Exchange to list $489,000 additional common stock of the Twin City Rapid Transit Company. The proceeds will be used for the extension in and about St. Paul. With the issue of the 4,890 shares of treasury stock the total outstanding issue of the common will be $17,000,000. All of the $3,000,000 preferred authorized has been out for some time. This makes the total outstanding share capitalization $20,000,000.

Representatives of the Chicago street railway companies now state that they are willing to sell their properties to the city on fair terms, but require more time to determine their value. They are having figures prepared showing their tangible assets and earning capacity. When these are ready, a meeting between the city officials of Chicago and of the railways will be held to complete negotiations. The traction companies agree to place no obstacles in the way of municipal ownership

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price May 20
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	204
Manhattan Elevated Railway	168
Metropolitan Street Railway	115¾
Metropolitan Securities	76
Ninth Avenue	197
Third Avenue	124
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	60⅜
Brooklyn City Railway	240
New Orleans Railway	4¼
Public Service Corporation (New Jersey)	121
Philadelphia.	
Consolidated Traction of New Jersey	83¼
Philadelphia Traction	100⅛
Union Traction	62¾
Boston.	
Boston Elevated	157
Massachusetts Electric Companies, com	16¼
do. do. do. pref.	66
West End Street, com	97½
do. do. do. pref.	116½
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	6⅝
do. do. pref.	45

ELECTRIC MANUFACTURING COMPANIES' STOCKS.

Name.	Closing price May 20
New York City.	
Allis-Chalmers, com	15¼
do. pref.	51⅞
Electric Boat, com	37
do. do. pref.	75
Electric Lead Reduction	¼
Electric Vehicle, com	12½
do. do. pref.	20
Westinghouse, com	152
do. pref.	190
General Electric	169
Boston.	
Edison Electric Illuminating	247
General Electric	170
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	155
National Carbon, com	62
do. do. pref.	116
Philadelphia.	
Electric Company of America	11⅞
Electric Storage Battery, com	81
do. do. do. pref.	81

TELEPHONE AND TELEGRAPH STOCKS.

Name.	Closing price May 20
Boston.	
American Telephone & Telegraph Company	139¼
Western Telephone Company	18
New England Telephone Company	138½
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210¼
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	172¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93
Chicago Telephone Company	130

MISCELLANEOUS STOCKS.

Name.	Closing price May 20
Otis Elevator Company	52
Consolidated Car Heating	64
Standard Underground Cable	200

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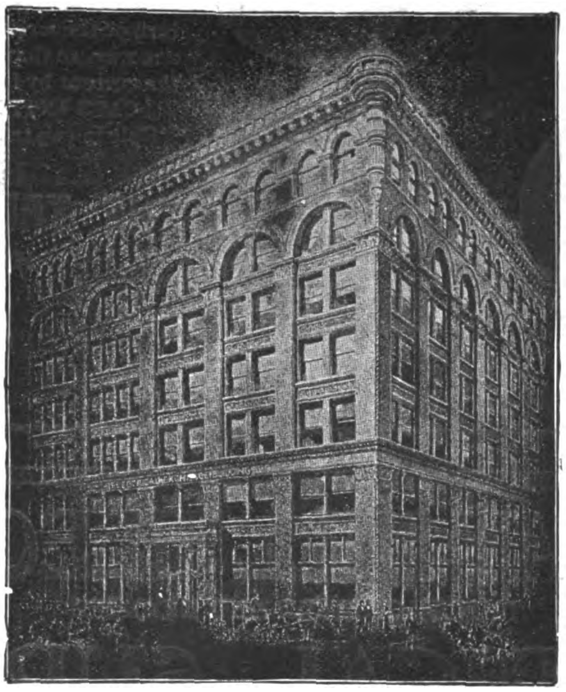

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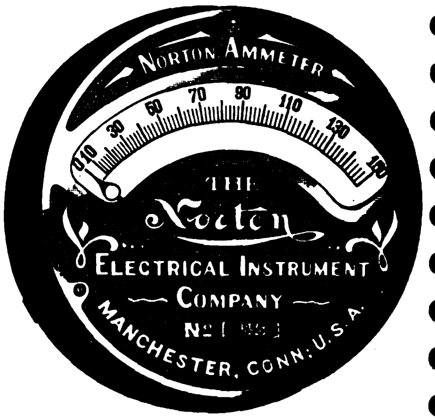
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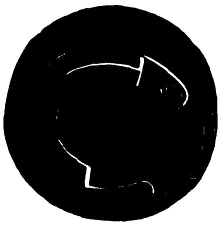
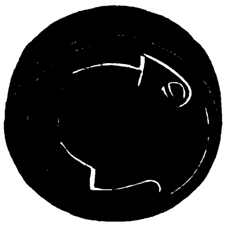
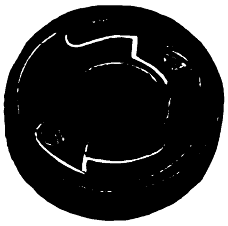

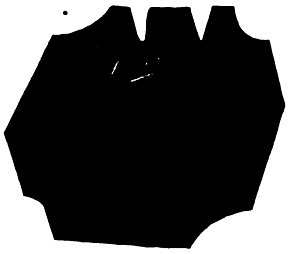

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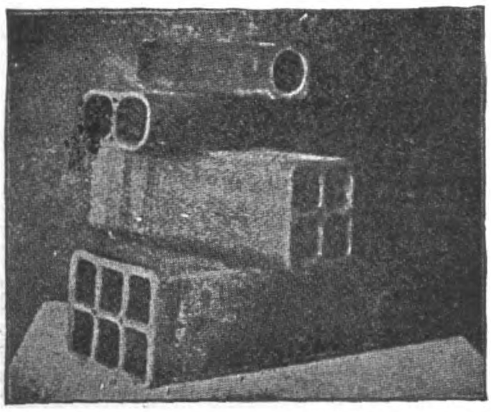

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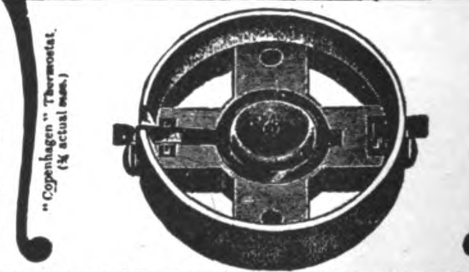

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EDITORIAL NOTES.

A Tribute to the Electrical Instrument Maker. The pride of accomplishment felt by the progressive and successful electrical engineer is legitimate in so far as it pertains to the influence of his own individuality on the work he has done.

In other respects, it seems as though a rather sluggish appreciation is felt by him for those through whom his victories become possible. It is a simple matter to take a bird's-eye view of the situation and thus to embrace the vastness of the industries inherently electrical, which contribute to the high reputation electrical goods have established for themselves in the open market. The hall mark of fame in this field is exactitude. The peculiar nature of electrical machinery and its allied devices is such that accurate information must be given with them. The rigid specifications of dynamo and motor construction, of arc and incandescent lamp manufacture, of wire making, and in fact all that pertains to up-to-date factory products, are only possible to-day through the magnificent work of our instrument makers. In no other field has American ability so demonstrated its remarkable scope as in this. A tribute to the American instrument maker is without doubt no more than a recognition of the most important influence in electrical manufacturing to which reference can be made.

Exactitude without the aid of these super-senses, would not only be problematic but inherently impossible. As the case now stands, the fineness of art possessed by our most skilled workers is but a crystallization of this fact. The instrument maker, the builder of exact meters by means of which volts, amperes and watts are accurately indicated, has been the healthiest of all influences in bringing about much of our activity. Without these aids we would be working in the dark. The power behind the throne, through which confidence is felt in construction and results, is the maker of fine meters. It is not so long since the difficulty of obtaining accuracy was a general proposition. The exhibitions that took place annually in New York, at what was then called the American Institute Fair, were for a time devoted to displays of electrical apparatus. On one of the tables a Forbes ammeter was to be seen; its inventor, Prof. Forbes, utilized the heated air cast off from a little coil of resistance wire to revolve a small and delicately mounted wheel. The wheel carried small mica blades and as the ascending column of heated air arose, the little windmill rotated and thereby operated a train of gears. The current was thus recorded with what was then considered a fair degree of accuracy. Imagine the conditions of to-day and of that period. Try to realize what it would mean to attempt rough and ready electrical testing with an ammeter of this description. Yet such was the situation in this respect in those days. How fortunate that they have passed. With what good cause should we congratulate ourselves that testing to-day is not what is was then. The merest tyro in electricity can accomplish more in testing than our best experts of the good old times.

* * *

The Increasing Extent of Interurban Lines. City construction now keeps pace with street railway improvements. The inter-relationship existing between civic expansion and street railway enterprise has been admitted by a variety of statisticians. And the increasing extent of interurban lines has been the means of instituting a comparison between the rate of development of municipal growth today, ten years ago, and what might reasonably be regarded as its equivalent ten years hence. Masterly theses have been presented on the subject of municipal development. The pros and cons of civic expansion have been argued down to the ground. All of the complications of city life have been reviewed from a social, moral and intellectual standpoint.

The merchants have been awakened from their lethargy with respect to these affairs, and now it seems as though one vast impulse is actuating the body politic. The drift of thought has been in one direction. It has for its ultimate purpose a hastened growth. The community, as it were, is being forced to agglomerate. The suburbs are stretching out far and wide with extraordinary rapidity. If it can be said that one characteristic is marked in the picture presented by live American cities, it is that their suburbs flourish almost before they do. The outskirts are more quickly threatened with congestion than the older and more staid centers of population.

London is an example of colossal expansion in this respect, and there is no reason to refuse to believe that history will not repeat itself in our case as well. New York now possesses about 4,000,000 inhabitants. London 8,000,000. Even though, as some might say, the floating population is considered in these figures, still the problem must be met of providing adequate accommodations for all. That being the case, in London, interurban lines have mastered the situation. In Baedecker's the length of this great city is reported as equal to 120 miles. Some would call this a State, not a city. Yet the future of Greater New York is such that this immensity may ultimately be dwarfed by it. What then will be the outcome of this in our own case. We have just finished a series of now indispensable tunnels. Others have been projected which will add to the convenience of ready transportation. The die, however, seems to have been cast.

New conditions have compelled the fact to gain recognition. The future of Greater New York is bound up in its interurban lines. As electrical progress dictates advance the cue is followed. Historically, and as evolution has left its mark, the stage coach, the horse car, the cable car, the trolley and now the third-rail system must be remembered. A great responsibility has fallen upon the shoulders of the electrician. The world is anxiously awaiting to see how he will discharge this great mission.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Dr. M. I. Pupin, of Columbia University, New York, has been elected a member of the National Academy of Sciences.

◆

The 51st meeting of the American Society of Mechanical Engineers will be held at Scranton, Pa., June 6-9.

◆

The United States Government has been invited to send delegates to the First International Congress for the study of radiology and ionization to be held at Liege from the 12th to the 14th of September next, under the patronage of the Belgian Government.

◆

Mr. James Dalrymple, Glasgow's municipal tramway expert, arrived in New York on Saturday, and after a reception in this city, given by enthusiastic admirers, left for Chicago where he will discuss municipal ownership with the Mayor of that city.

◆

Another union of street railway employes has been formed in New York and it is said the workers on the Interborough lines may strike again.

◆

Mayor Weaver of Philadelphia has won his fight and the gas lease is dead. The United Gas Improvement Company on Saturday formally withdrew its proposition for a lease. There is now a square chance in that city for electric light companies.

◆

A dispatch from Cambridge, Mass., says a telegram was received at the Harvard Observatory May 27 from Prof. Percival Lowell, director of the Lowell Observatory at Flagstaff, Ariz., stating that the canals of Mars have been photographed there for the first time. Several of them appear upon more than 20 negatives.

◆

A recent letter from London states that "Sir William Ramsey strongly advises that the Government be empowered to send out experts to Cornwall where radium has been found, as the supply of the wonderful substance is nearly exhausted in England—while Austria, the only country where radium is found in quantities, has forbidden the export of it. An ounce of radium is at present worth $900,000. 'Radium is almost priceless now,' said Sir William, 'for the simple reason that we cannot get any from any other country, and we do not exploit the few sources we have here in England. It is a great pity that no radium has been found in the United States, as the energetic people of that country would lose no time in geting it on the market. Sometime ago, however, when radium was one-twelfth its present price, many wealthy private persons bought small quantities of radium to place in their museums, or simply as a curiosity. I think if those people knew how willing we were to pay a reasonable price, that is, probably ten times what they gave for it, they might be willing to come forward and sell it to us. Moreover, they would be conferring a great national benefit by enabling us to continue our researches."

◆

The Massachusetts Legislature has appointed members from both branches to act on a special commission to meet during this summer to consider the advisability of revising the present laws affecting railroads and street railways. The appointment of this committee is the result of the bills before the Legislature this year which met defeat, providing for the purchase of electric street railways by Massachusetts steam railroads and the building of the Boston and Providence trolley road.

◆

At a meeting of the directors of the Westinghouse Electric & Manufacturing Company in New York last Thursday, E. M. Herr was elected first vice-president with executive powers. Mr. Herr has been vice-president and general manager of the Westinghouse Air Brake Company.

◆

A cable dispatch from London to the daily papers says that "a clock that will run for 30,000 years without winding is the latest use to which radium has been applied. The instruments, which are being sold at $50 each, are the invention of H. G. Strutt, and have been put into practical form by a well-known clockmaker of New Cavendish street. The new invention is very simple in construction. One-twelfth of a grain of radium is suspended over a small electroscope consisting of two thin strips of silver. These, being charged with electricity or radio-activity from the radium, move apart until they touch the sides of the vacuum tube in which they are fixed. There they communicate their charge to an aluminum wire which rings a bell and being discharged fall together again to repeat the process indefinitely. The ringing of the bell occurs with such unvarying regularity that the making of the instrument into a time recorder is but a matter of detail. At present the radium clock is made in two forms, one for the magic lantern, the other for the lecture desk to demonstrate the peculiar powers of radium."

ELECTRICITY ON A GERMAN WARSHIP.

The liner "Preussen," which was launched from the Vulkan shipyards in Stettin, Germany, at the end of 1903, and which until very recently was at anchor at Swinemunde, is to be put into service and will be attached to the Baltic marine station this month, says the "Electrical Engineer," London. It has three screws and is about 400 feet in length, 70 feet in breadth and 25 feet in draught, with a displacement of 13,200 tons. It develops a speed of 18 knots, the capacity of her engines being 16,000 hp. The vessel is fitted with a belt armor of 225 mm. and an armored deck of 75 mm. thickness. Her artillery equipment comprises four quick-charging guns of 12-inch gauge, fourteen 7-inch quick-charging guns and twelve of 3¾-inch gauge, twelve 1½-inch machine guns, and eight machine rifles, in addition to six torpedo-launching tubes. Her crew consists of 697 men.

All the internal rooms as well as the upper deck are lighted by electric glow lamps. For use in connection with the scouting service in action or, generally speaking, whenever the enemy is close by, as also for signaling to a distance, there are used four large projectors of 61 million normal candle-power each.

Electromotors are being used extensively for such purposes as conveying ammunition from the ammunition stores to the guns, moving the rotating armored gun-turrets, handling coal, lowering or hauling the large boats, operating the machine tools and refrigerating plant, as well as for driving the numerous fans of different sizes which are installed in all the compartments of the ship.

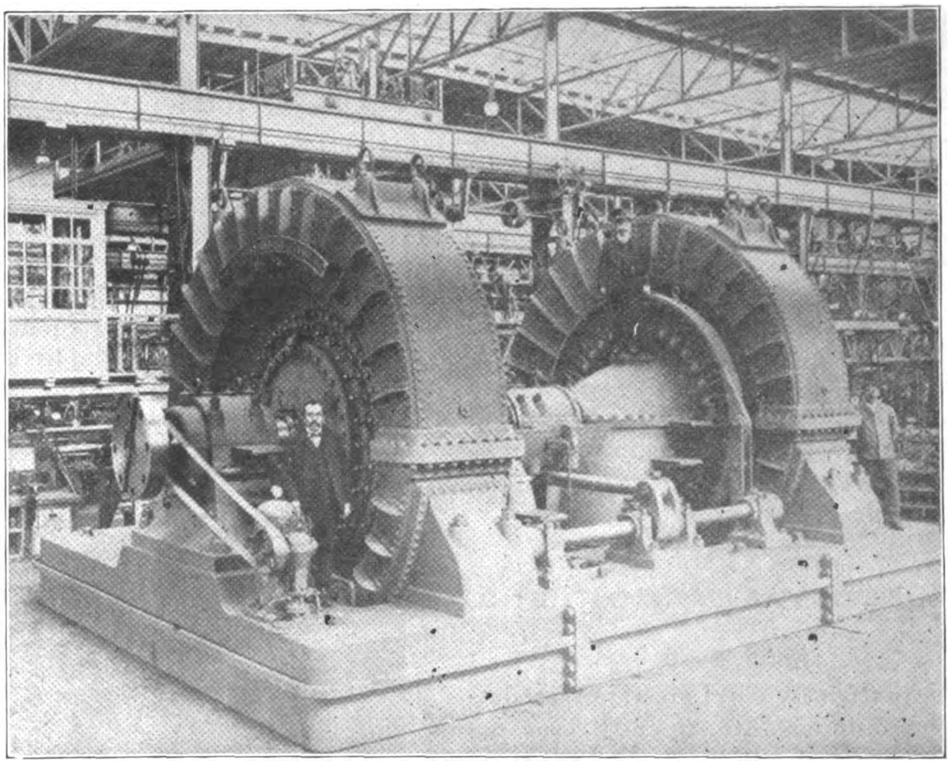
The whole of the apparatus used for the transmission of orders from one part of the ship to another, as well as for mutual communication between different places—i. e., the telegraphs controlling the rudder, engines, boilers, artillery, and torpedo rooms—the optical signaling apparatus for the transmission of orders and intelligence from ship to ship or from land to ship, the telephone and alarm plant, the medical outfit of the infirmaries, and instruments indicating the depth, etc., are operated by electricity.

The whole of the above machinery and apparatus has been constructed by the Siemens-Schuckert Works, which syndicate also installed the two central stations supplying the current for their operation as well as the one required for the "Telefunken" wireless apparatus.

LARGEST ELECTRIC LARGEST WATER TURBINE.

BY RAY HAMILTON.

Two of the most recent and withal interesting notes in hydro-electrical engineering, are the arrival of the largest horizontal water turbine ever constructed, and the installation of the largest electric motor ever built. The first is a gigantic machine of the horizontal inward-flow, double Francis type, and is the first one of 20 that are to convert Niagara's energy into 200,000 hp.



Largest Horizontal Water Turbine Ever Constructed.

This is the first one of four similar turbines built for the Ontario Power Company. The great turbine now assembled was constructed in Wurtemberg Germany, where the others are now being built as rapidly as possible.

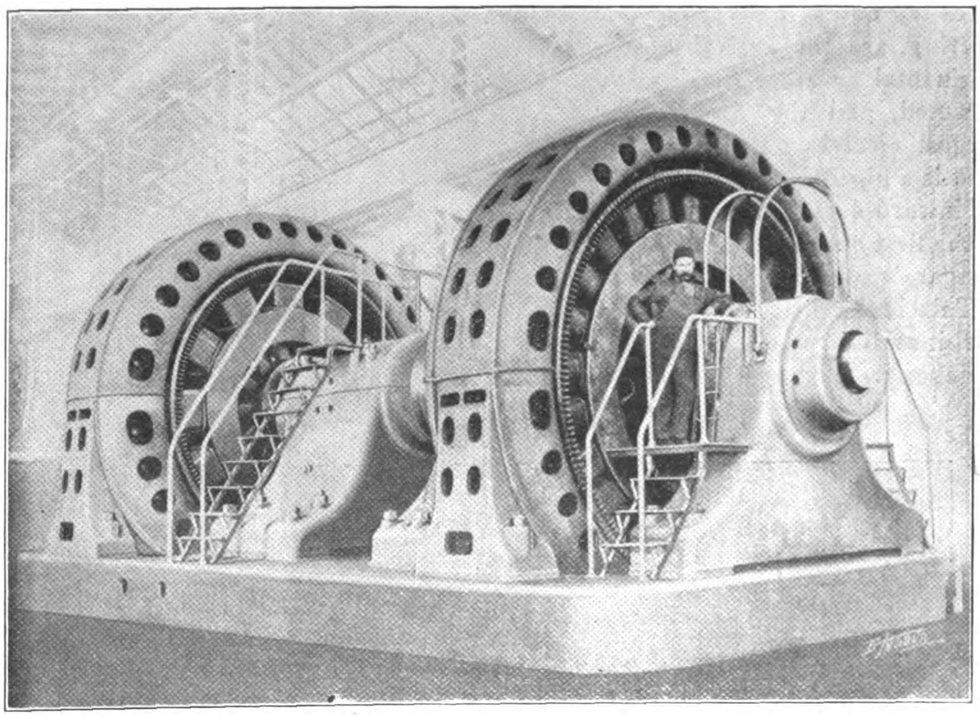
The second machine has just reached Niagara Falls, the third is on its way, and the fourth is nearly finished in the German shops.

Each of these water turbines develop 11,300 hp. when using 700 cubic feet of water per second, and when operating under a head of 175 feet and making 187½ revolutions per minute. In these turbines there are two running wheels, each of which are 78 inches in diameter; water is delivered to these by penstocks 9 feet in diameter and these are brought into the power house below the level of the floor. Where these penstocks enter the building, heavy thrust flanges are embedded in the massive concrete wall, forming as well the foundation of the building. The thrust of the water in the column is equal to 650,000 for each turbine; the latter is set so that the shafts of each are parallel to those of the penstocks and therefore the pipes that furnish them with water, have to describe an arc equal to an angle of 90 degrees on the horizontal, and 45 degrees upward, while each supply pipe ends in a housing of heavily reinforced plates.

Owing to the narrowness of the gorge, the water level of the river varies greatly, and to compensate for this the tail race is separated from the river by a weir with a crest of 7 feet above the normal level of the river. The head of water is made up of 155 feet above the center of the shaft, and 20 feet below it, and the draft tube and tail race below the level of the floor are entirely of concrete. Swivel gates, which act as guides, are also utilized to control the water at the turbines, while these will be regulated by Lombard governors; each penstock has a relief valve, which discharges into the tail race.

The largest electric motor in the world has just been installed in the power house of the Shawinigan Water & Power Company in Canada. It is a synchronous motor developing 8,000 hp., while the generator, which is direct connected with it generates 5,750 kw. when running 300 revolutions per minute.

The motor and its complementary generator are not only exceedingly large machines, but their combined rated capacity of 12,000 kw. seems little short of marvelous when the exceedingly limited floor space is taken into consideration. This brilliant example of electrical engineering skill was constructed by the Allis-Chalmers Company at its Cincinnati (Bullock) Electrical Works, and tested by the Behrend system in the shops with an expenditure of only 300 kw., and which effected the same losses the motor-generator would indicate under full load conditions, and would be equivalent to 72,000 kw. on the generator. The photograph was taken at the time the test was made.


Largest Electric Motor Ever Built.

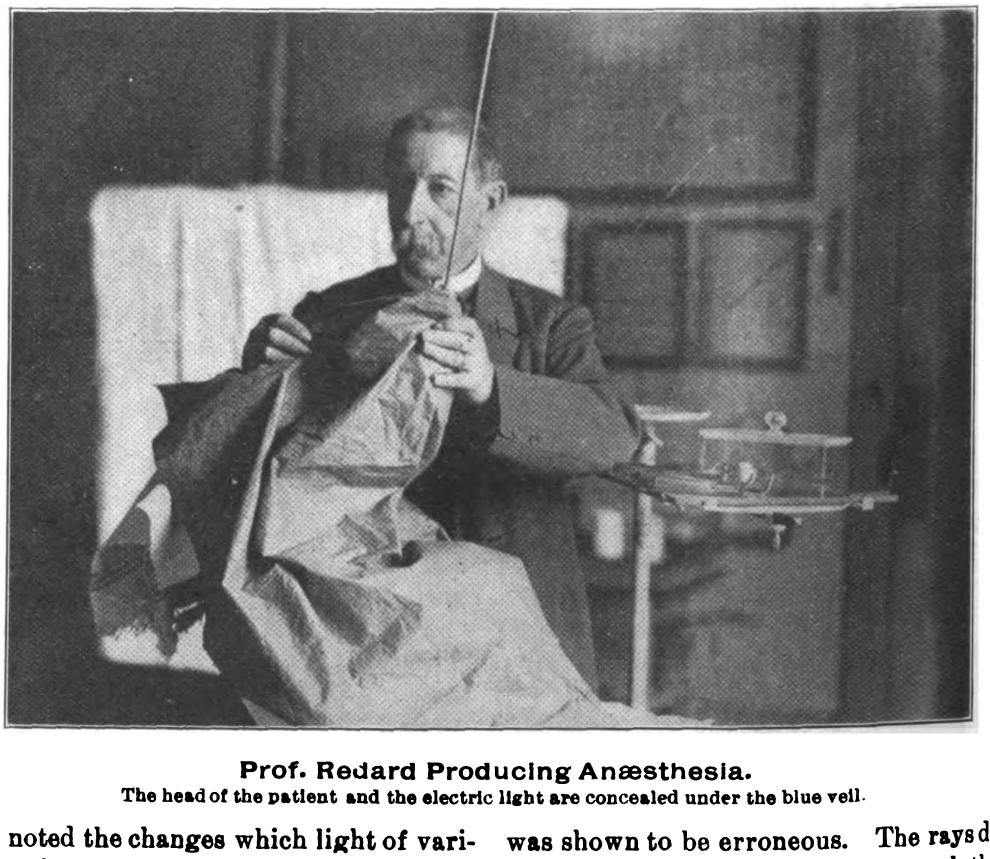
BLUE LIGHT AS AN ANÆSTHETIC.

BY C. SMITH.

An extremely novel process of producing anæsthesia has recently been devised by a Swiss doctor, Prof. Redard, of Geneva. The method itself is a very simple one and entirely harmless, being used by the professor for minor operations in dentistry, such as removing teeth, entirely doing away with the use of nitrogen monoxide or laughing gas, ether and chloroform.

A blue electric light of 16 cp., a dark blue veil or sheet and a nickel reflector are all that is needed. The patient is placed in a reclining position with the head entirely covered with the blue veil and the light underneath the sheet about 6 inches from the subject's eyes. By intently looking at this light the pupils immediately begin to dilate and in three minutes the operation can be performed without any pain being felt, the patient, on awakening, stating that he remembers nothing whatever during the time he was under the influence, and in one case even demanded to see the tooth in order to be convinced that it had really been extracted.

In an address to a medical society, the doctor stated that he had begun the study of the action of the primary colors, red, yellow and blue, and their complementary colors on inorganic and organic bodies. He noted the changes which light of various colors produces on different chemical compounds, as well as the influence which light has on both plants and animals, such as the differences in the color of the former, depending on whether they grew in the shade or sunlight; and the effect of climate on both habits and character of man and animals; the southern countries with their love for bright, gay colors and the north with its more sombre and dark colors. He concluded that heat and light were the cause. Inasmuch as various scientists, such as Flammarion and Finsen, had already shown the action of various rays on animals, he began his investigations along somewhat similar lines, noting that various colors produced different effects. For instance, red had a very disagreeable action, producing intense excitement; yellow, melancholy and mental depression; blue, calmness and quiet; while their complementary colors produced depending upon the predominating primary color. The doctor ascertained that blue was the most suitable for his use, although both green and violet could be used. In his experiments he has met with a fair degree of success. About 20 per cent. of his trials were, however, failures, and this he attributes to the fact that "the patient did not fix his eyes steadily upon the blue light," but insisted on closing them.


Prof. Redard Producing Anæsthesia.
The head of the patient and the electric light are concealed under the blue veil.

A hypnotic effect was at first thought to be the cause of the sleep produced, but inasmuch as red light or yellow light, for example, produce, under the same conditions, totally different effects, this theory was shown to be erroneous. The rays do act, however, upon the brain through the optic nerve, in some manner producing anaesthesia. The same method has been tried by various colleagues of the professors who have also obtained good results.

The patients have only been under the

influence of the light for a short time, and in consequence whether or not this method can ever be used for more important surgical operations is extremely problematical.

A NEW BATTERY SWITCH.*

A serious objection to the ordinary charge and discharge switches is the large number of heavy copper connections between the battery and the switch which they necessitate, and many attempt's have been made to reduce this number of connections. One way of doing this consists in connecting several cells, instead of only one cell, between each pair of switch contacts, and then reducing the voltage variations to 2 volts by means of auxiliary cells. This method, however, involves difficulties in charging the auxiliary cells, as these must either be charged separately from some independent source or else the whole battery must be quite disconnected from the bus bars during the charging period. A better method consists in using a few of the cells from the other end of the battery in place of independent auxiliary cells, and in a paper recently read by Herr C. Liebenow before the Elektrotechnischer Verein (E. T. Z., May 4, 1905) the theory of this method is considered in some detail.

An installation of this type has been at work for some time at the Paris terminus of the Northern of France Railway. In this case two cells are connected between every pair of contacts on the main cell switch, whilst a single cell at the other end of the battery is connected to a second switch and every time the main switch is moved this auxiliary cell is either inserted or withdrawn automatically.

Fig. 1 shows diagrammatically the connections of a battery installation arranged on this principle. At the right hand end of the battery, every fourth cell, for instance, is connected to the main cell switch Z, while at the left-hand end three consecutive cells are connected to the auxiliary cell switch H by means of four conductors. The mechanical interconnection of the two switches is not shown. In order to vary the circuit voltage between J_1 and J_2 by steps of 2 volts only, the auxiliary switch alone would be moved at first so as to cut out a single cell at a time, the main cell switch remaining fixed. After all the three auxiliary cells had been cut out the next step would consist in moving the main switch over one contact, and, at the same time, moving the auxiliary switch back on to the last cell of the battery. These two movements should take place as nearly as possible simultaneously in order to avoid fluctuations in the lights. In this cycle of operations it will be seen that the auxiliary switch first makes three steps of 2 volts each and then one of 6 volts, so that if the short-circuiting of the cells were prevented by means of the ordinary resistance inserted between the front and back parts of the contact arm, this resistance would be very unequally loaded at the different steps. The difficulty can be easily overcome, however, by returning to the older type of cell switch, in which the double contact arm is replaced by intermediate resistance contacts introduced between the main contacts (see Fig. 1, H).

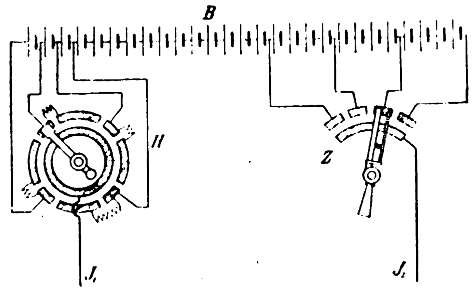


FIG. 1.

A simple formula for deciding the best number of cells to be placed between each pair of main switch contacts, in order to reduce the number of connecting leads to a minimum, is given by Herr Liebenow:

Let N = maximum number of cells to be cut out.
H = number of auxiliary cells.
L = number of connecting leads (including the leads at both ends of the battery).

Then $$L = \frac{N + H^2}{H + 1} + 2.$$

is the general formula, applicable both to the case in question and to the ordinary method of cell switch connection (where $H = 0$, of course). From this expression it is easy to show that, for a given value of N, L will be a minimum when $H = \sqrt{N+1} - 1$. Thus, in the case of a battery requiring a total of 35 regulating cells (a variation of 70 volts), the number of connecting leads between battery and switch with the ordinary type of cell switch would be 37, whilst with the new arrangement, if H is made equal to $\sqrt{N+1} - 1 = \sqrt{35+1} - 1 = 5$ auxiliary cells, the total number of leads will be $L = \frac{35 + 25}{6} + 2 = 12$, or a saving of about two-thirds of the copper as compared with the ordinary arrangement.

The way in which the number of leads varies with H may be seen from the following tables, giving the number of leads for various values of H for batteries having 57 and 20 regulating cells respectively:

57 Regulating Cells.

H		L
0	(Ordinary cell switch)......	59
1	" " "........	31
2	" " "........	23
3	" " "........	19
4	" " "........	17
5	" " "........	16
6	" " "........	16
7	" " "........	16
8	" " "........	16
9	" " "........	16
10	" " "........	17

20 Regulating Cells.

H		L
0	(Ordinary cell switch)......	22
1	" " "........	13
2	" " "........	10
3	" " "........	10
4	" " "........	10
5	" " "........	10
6	" " "........	10
7	" " "........	11

It will be seen that the change from no auxiliary cells to one auxiliary cell produces the most marked saving in leads, and after that the saving affected by each additional auxiliary cell gets less and less until a minimum (not very well defined) is reached. The maximum saving, as compared with the ordinary arrangement, is greater, the greater the number of regulating cells.

Whether it is advisable in any particular case to employ the number of auxiliary cells giving the maximum saving in leads depends on the constructional details of the switches and on the actual size of the conductors required, because, of course, it is the minimum combined cost of switches and leads and not simply of leads alone which is desired. In the case of cell switches of the ordinary type, with a large number of contacts, it is probable that the new type of double switch would come out the cheaper because of the reduction effected in the number of contacts.

Wireless System for Pacific Coast.

A wireless telegraph system, embracing the Pacific Coast from San Diego, Cal., to Bremerton, Wash., will be installed during the summer. Stations will be erected at Cape Mendocino, Point Arguello, Point Loma, Cape Blanco, North Head, Cape Flattery, Point Wilson and the Puget Sound Navy Yard. The stations will be so situated that vessels cruising off the coast will have a communicating range of about 100 nautical miles from shore.

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*From the "Electrical Review," London.

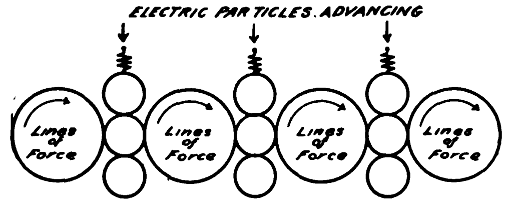
ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

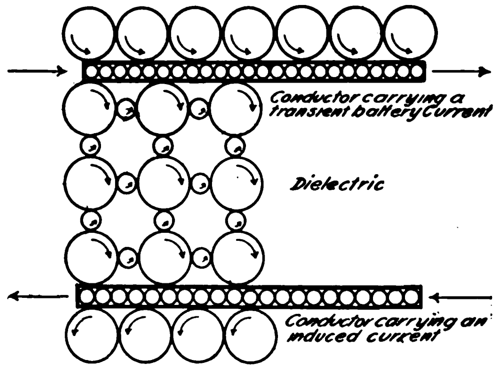
TELEGRAPHY WITHOUT WIRES.

The Origin of Wireless Telegraphy.—In speaking of the origin of wireless telegraphy it is necessary to begin at that point in its history which might properly be called the first suggestion. On this score many arguments may arise, presented on the one hand by the physicist and mathematician, and on the other hand by the practical inventor. It is generally acknowledged, however, that the first correct analysis of the conditions which gave rise to that which is called wireless telegraphy were made by Hertz. It can also be admitted that the influence which guided him in his experiments was Clerk Maxwell. What is there in the work of either of these great thinkers that led to such momentous results as those recorded in the history of wireless telegraphy? To begin with, the basis of Maxwell's mathematical investigations, was the long series of epoch-making experiments by Michael Faraday. The point which arose first in the minds of both men, was whether electrical actions took place in the conductor or the medium surrounding it. In other words, whether electrical effects take place through the intervention of a definite mechanism—or, to be still more explicit—whether the lines of force emanating from any center of electrical disturbance are not the connecting links between the first manifestation and whatever secondary or tertiary effects may follow. It is quite evident that as the study of wireless telegraphy is only a practical proposition, because of the possibility of throwing out into space an influence or waves that produce signals at distant places, it is necessary to examine as closely as possible the meaning of such an experiment in order to understand more fully the limitations of this new art of signaling. The general conclusion arrived at by Maxwell was that of the existence of a universally diffused medium called ether. Of the nature of this substance nothing is known, yet it is acknowledged to be that through which all energy is transmitted; and in this respect it is of particular interest to electricians because of the form of electrical energy it seems peculiarly adapted to carry.

Hertz's Experiments.—According to the ideas of Maxwell, an electric current is due to the *displacement* of electricity; in other words, Maxwell looked upon electricity as an actual thing, a something that had to be displaced to manifest itself. He therefore came to the conclusion that two influences were at work, one which was called a line of force and the other the electric particle. The electric particle acted as a transmitting gear between two larger gears, which were the power carriers. The picture presented would be that of an alternate series composed of a large gear and a small gear, a large gear and a small gear, etc., the larger gear being the line of force, the small gear the electricity. The next feature in this theory is that of remembering that the larger gears tend to thrust forward or displace the smaller gears while using them as transmitters of their rotations.

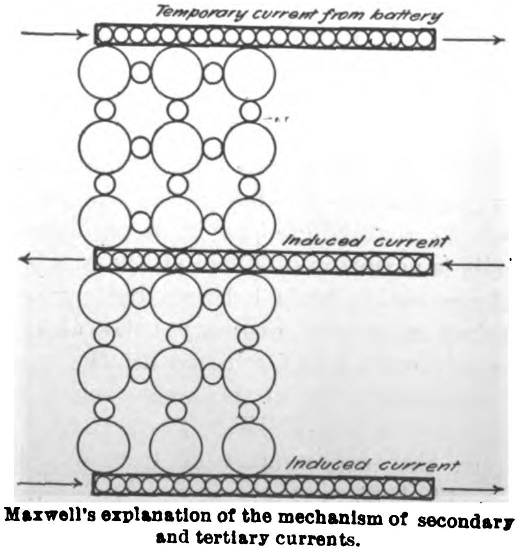


Rotating magnetic vortices, showing how electric displacement occurs according to Maxwell—the dielectric holding the electric particles in place.


Conductor carrying a transient battery current
Dielectric
Conductor carrying an induced current

Sketch showing electro-magnetic induction between two wires, the Maxwell mechanism accounting for the induced current by means of the electric particle and magnetic vortex.

A temporary displacement would exhibit itself as a temporary flow of electricity. A continuous displacement would appear in the form of a constant current; thus the mechanism postulated by Maxwell simply consists of the relative actions and reactions between two sets of unslippable molecular or atomic wheels, so to speak. He was able, on this basis, to advance certain formulas by means of which, on the supposition that the medium transmitting electrical influences is elastic, to calculate the speed with which disturbances would be propagated.



Maxwell's explanation of the mechanism of secondary and tertiary currents.

The formula given for an elastic medium, such as the ether, by which this speed of propagation is ascertained, is: Speed of propagation = the square root of the effective elasticity ÷ the density. This simple formula appears as $v = \sqrt{\frac{e}{d}}$

where v = velocity of propagation in the ether,
e = effective elasticity,
d = density.

The value of e and d may be better understood as follows: In a medium like ether, which transmits electrostatic and electro-magnetic disturbances the *electro-magnetic density* must be given. Its value is $d = 4\pi\mu$, where μ = the magnetic permeability and $\pi = 3.1416$. In addition it must be known that the effective elasticity of the ether or the dielectric is equal to $4\pi \div K$, where π as before = 3.1416 and K = the specific inductive capacity.

Arranging these symbols in the proper manner gives the following result:

If $v = \sqrt{\frac{e}{d}}$

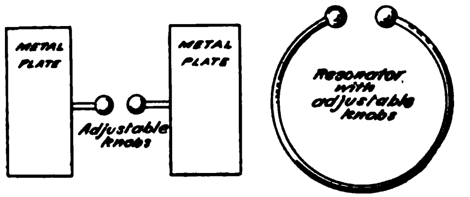
and $e = \frac{4\pi}{K}$ and $d = 4\pi\mu$, then substituting

$$v = \sqrt{\frac{4\pi}{K}} \div \sqrt{4\pi\mu} = \frac{1}{\sqrt{K\mu}}$$

This last formula is a statement that the velocity of propagation of a wave of electric or magnetic disturbance is equal to the square root of the reciprocal of the product of its specific inductive capacity and its magnetic permeability (see Fleming's Alternate Current Transformer).

These conclusions, based upon a mechanical conception of the process taking place, are not to be regarded as conclusions drawn from actual operation of the true mechanism. The mechanical interpretation by Maxwell is an ingenious hypothesis which in many ways presents a method of transmitting electricity that will be hard to replace. It also explains the means by which waves are propagated, including the magnetic and static. The development of wireless telegraphy rests largely upon the application of correct principles to the problem. No one has been of greater importance in this respect than Dr. Hertz, who subsequent to Maxwell's time attempted the demonstration of some of the propositions indicated by him in his mathematical investigations. His labors were confined to a determination of the velocity of propagation of electric waves superinduced by electrical oscillations in condensers. It is interesting to glance over the ground covered by him in his efforts to throw light on this subject and the remarkable discovery made in consequence of his close attention to all the results obtained.

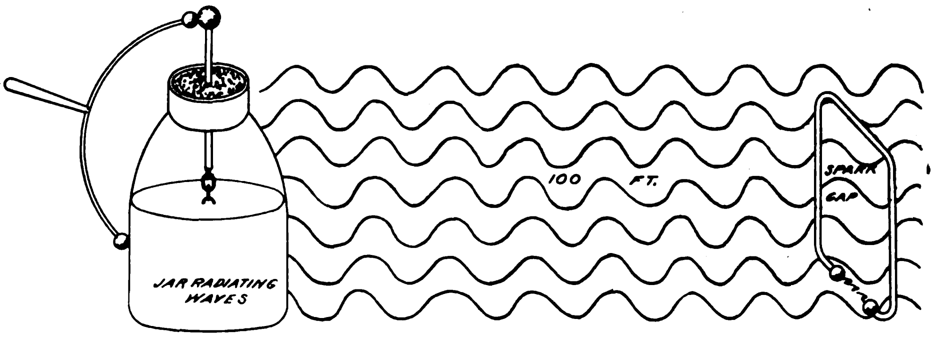
Hertz's Discovery.—During experiments, conducted for the purpose of ascertaining the velocity with which electric waves move through space, Hertz discovered sparks at various points in his circuits which were strongest where the wall seemed to act as a reflector. He was able to trace the reflected waves and to measure them, and arrived at the astounding conclusion that conductors carrying an oscillating current were throwing out into space waves in every respect similar to light though invisible.



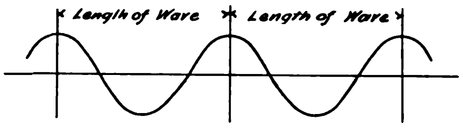
Apparatus used by Hertz for investigating electric waves.

The First Use of a Spark Gap.—Hertz employed for the purpose of localizing and *seeing* these waves a resonator, as it was then called. It consisted of a metallic circuit broken at one point by a *small air gap*. He was able to refract these waves by means of a prism of pitch through an angle of 22 degs. He found that metal screens were opaque and wooden doors transparent to the waves. By means of mirrors of sheet zinc the light was reflected and focused. In other words, it was clearly established by his experiments that oscillating currents threw off or radiated great waves in the luminiferous ether, waves which to-day are employed by famous workers in the field of wireless telegraphy.

Producing Electric Waves.—It is a simple experiment to set a Leyden jar in the middle of a large room and after charging it to suddenly discharge it. The effect of this process is to throw out from the jar an immense number of electric waves. It is in every respect the same as though a powerful source of light was suddenly turned on for an instant. Waves are generated by this method whose length and number per second are dependent upon the capacity of the Leyden jar and the resistance of the circuit through which it is discharged. If the resistance of this path is high the number of waves or oscillations will be reduced; the lower the resistance of this path the more rapidly will the oscillations increase. In cases where these results have been calculated the waves have exceeded many millions per second. Visible light represents vibrations of the ether, reaching up from 400 to 700 billion per second. Electric waves only reach into the millions per second. Therefore, the upsetting of a condenser or Leyden jar discharge means the development of vibrations which occupy a position midway between rapid aerial and visible light vibrations.

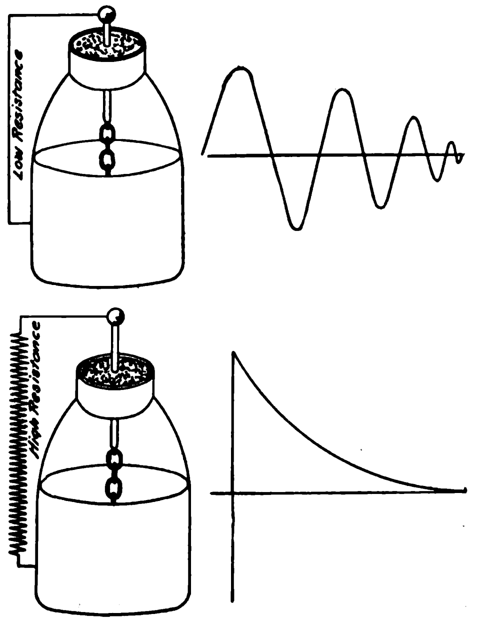


Principleof wireless telegraphy illustrated with Leyden jar and spark gap in path of waves and development of spark at a distance.



Method of measuring waves.

Resistance in Series With a Condenser.—When the inductance of a circuit in series with a condenser is given in henries and its resistance as well in ohms, then if the capacity is given, oscillations can be predicted on discharge. If the resistance in ohms is *greater* than the square root of 4 multiplied by the inductance, divided by the capacity, there will be *no oscillations* and consequently *no waves*. If the resistance in ohms of the circuit is *less* than the square root of 4 multiplied by the inductance and divided by the capacity there will be oscillations and therefore waves.



Discharge curve, showing oscillations from jar through a low resistance, and dying away of charge through a high resistance.

The Number of Waves a Second.—To calculate the number of waves a second the following items must be known.

First—The resistance in ohms = R.

Second—The capacity in microfarads = K.

Third—The inductance in henries = L.

The formula employed is one in which these values are correlated as follows:

$$2 \times 3.1416 \times \text{number of waves} = \sqrt{\frac{1}{KL} - \frac{R^2}{4L^2}}$$

If the resistance R is very small, so as to be negligible in fact, the formula becomes transformed into the following:

$$\text{Waves per second} = \frac{1}{2 \times 3.1416 \times \text{sq. root of } (K \times L)}.$$

Length of a Wave.—If the number of waves per second are known, then it is simply necessary to divide this number into 186,000 miles or its equivalent 3×10^{10} centimeters, the velocity of light per second. For instance, if by the above formula calculation showed a number of electric waves equal to one million per second, then $3 \times 10^{10} \div 10^6$ would give 3×10^4, or 30,000 centimeters for the length of each wave. If the number per second equalled 100,000,000 then each wave would possess a length of 300 centimeters, about 120 inches.

TELEPHONE TRAFFIC.[*]

BY HERBERT LAWS WEBB.

A paper on telephony before this Institution is under a certain disadvantage because it is difficult to tell the earnest telephone men anything about telephony that they do not already know and it is difficult to tell the non-telephone men anything about telephony that they care to know. In attempting to describe the improvements that have been made in the conduct of telephone traffic and to indicate the relation between traffic efficiency and engineering economy I shall hope at the least to provide a topic for discussion which may interest those members who are not directly engaged in telephony as well as those who are.

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[*] Abstract of paper read before the British Institution of Electrical Engineers, May 11, 1905.

I have always held that the study of the traffic is the most important part of a telephone man's work. The chain of reasoning which leads to this conclusion is simple. The sole object of a telephone system is to supply telephonic communication, and telephonic communication consists of hundreds or thousands, or hundreds of thousands, of daily telephone connections. Each connection consists of a certain number of operations involving a definite performance by apparatus and by a manipulator, therefore the principle aim of the telephone engineer should be to put the apparatus and the manipulators in a position to execute those various operations with maximum accuracy and celerity. The efficiency—efficiency here meaning accuracy combined with celerity—of the individual connection is the object to be attained, and efficiency of the connection requires efficiency in each step.

Even if the result were solely the supply of the most effective service possible to the public, the accurate and rapid production of the individual connection should be the chief solicitude of the telephone engineer. But the matter goes much deeper than that. It affects the whole engineering design of the system, and it affects both the capital charges and the working costs. Any gain, however slight, in the accuracy or the rapidity of manufacturing the individual telephone connection is felt throughout the whole system. It reduces the size of the plant in proportion to output and so reduces capital charges, and it reduces the amount of work done in proportion to output and so reduces working costs.

I have read somewhere a remark, attributed to a famous member of this Institution, which aptly illustrates the point. Sitting on a mountain side, he said—"I let fall this grain of sand, and the whole earth feels the shock." Telephone men might well use this as a text. If in a telephone system, where hundreds of thousands, sometimes even millions of operations are performed daily, we make any one of those oft-repeated operations more accurate or more rapid, the whole system feels the effect. The gain of a second, or of a fraction of a second, on an operation many times repeated each day, has, in a large telephone system, a cash value running into handsome figures.

The importance of the study of telephone traffic, then, cannot be over-estimated and it is clear that the efforts of all who are engaged in the design and conduct of telephone systems are ultimately focused on the production of accurate and rapid telephone connections. There are many different functions to be performed in a modern telephone system, as there are in a modern battleship, but the true function of the battleship is straight and rapid shooting, and the true function of the telephone system is straight and rapid operating. The cook of the battleship does his share in straight and rapid shooting by keeping the gunners' digestions in order, and in the telephone system even the humble wayleave officer or the storekeeper has his indirect share in the production of accurate and rapid operating.

The improvements in telephone exchange apparatus during the past 10 years have been revolutionary. The history of telephone exchange working, covering now about 25 years, may be roughly divided into two periods—one of about 16 years in which the apparatus was mainly experimental and many different systems were tried, but none was produced capable of dealing with a large daily traffic with real accuracy and rapidity; and one of about 8 years, in which there has been perfected and standardized apparatus, largely automatic in its working, capable of the greatest accuracy and rapidity in operation. In the old apparatus the percentage of error was very great, owing to the distances between the signals and the jacks and plugs they were related to, and owing to lack of definiteness in some of the signals—on many occasions they worked at the wrong time and on others they failed to work when required to. With regard to rapidity of operating, the old apparatus was relatively slow in working for a variety of reasons. The distance between the signals and the jacks and plugs imposed a certain strain on the operator's attention and memory, the replacement of signals occupied time and the lack of definiteness of some of the signals and the total absence of some essential signals necessitated a certain amount of supervision of each connection by one or more operators to insure a reasonably accurate and satisfactory service.

In the standard apparatus of to-day all these conditions have been changed. The use of lamp signals enables many things to be done which were impossible before. The prime advantages of lamp signals are that they are extremely compact, they have no working parts, and therefore may be placed in any position, vertical, horizontal, or at any angle; they are automatic in action or self-effacing, since the signal disappears immediately the current is cut off; and finally, they give a much more positive and assertive signal than any form of indicator. These various qualities enable several radical improvements to be made. The signals are placed immediately adjacent to the jacks or cords they control, which, in large switchboards, is impossible with electromagnetic indicators; the line lamp is immediately above or below its corresponding answering jack and the supervisory lamps are in line with the connecting cords and close to them. With this arrangement the operator loses no time and has to exert no brain-power in tracing the relation between the signal and its corresponding jack or cord. The difference in effect between the modern arrangement of directly associating the signals with their corresponding jacks and cords and the old arrangement of placing the signals in a separate part of the board from that occupied by the jacks and cords is something akin to the difference between a telegram in plain language and one in code. In the one case the meaning of the signal flashes instantly to the brain of the operator, and in the other case a certain effort, and a certain interval of time, are required for translating the meaning of the signal. The automatic working of lamp signals is of much wider range than that of electromagnetic signals. We had self-effacing, or automatically restored, indicators before lamp signals were introduced, but the self-restoring indicator had but two positions—only two words in its vocabulary, so to speak. The lamp signal has several; it may be alight or out, corresponding to the down and up positions of the indicator, but it may also flash and it may be made to flash at different rates of speed, easily recognizable. Therefore, apart altogether from the fact that it is much more easy to apply to lamps distinctive marks indicating different classes of service than it is to apply such marks to indicators, the lamp signal is able to convey a greater number of meanings as a working signal than an indicator. Finally the more assertive and positive signal given by a lamp as compared with an indicator is due to a simple physical fact—the great sensitiveness of the eye to light. The glowing of the lamp signal instantly attracts attention, no matter at what angle the lamp may be relative to the eye, and in many cases the lamp is seen instantaneously where a fallen drop would be unnoticed for several seconds. The lamp is seen out of the corner of the eye, so to speak, whereas an indicator must be more directly in the range of vision.

Perhaps the most striking improvement in operating resulting from the use of lamp signals and the supply of energy from a central source is automatic supervision. In the older systems of working, as has already been said, the indefiniteness and unreliability of the signals made it necessary, in order to reduce as far as possible the percentage of error, that the operator should give each connection a certain amount of supervision. This supervision was directed to ascertaining that the two subscribers had got together all right, and later, in the many cases where the disconnection signal was not given, of ascertaining whether the subscribers had finished talking and the lines could be disconnected. This supervision demanded a certain amount of the operator's time on each connection in excess of the time actually required for the operation of the connection. In the modern switchboard the exact condition of the two subscribers' lines connected is shown by the state of the two supervisory lamps associated with the connecting cords. By the automatic working of these two signals the operator knows when the called subscriber answers, she knows when one subscriber hangs up and the other does not; she knows if either subscriber wants her to come in on the line, and finally she knows when the two have hung up. The operator sees these various conditions of the line by the action of the two lamps and she requires to do no direct supervision. If either subscriber desires to attract her attention he flashes one of the supervisory lamps by moving his switch-hook up and down, and it is only on this signal that the operator goes into the circuit. The automatic supervision and the automatic and definite disconnection signal afforded by the double supervisory signals constitute an immense advance in the means of handling telephone traffic.

The general supervision of the service becomes much more effective with standard apparatus because the lamp signals are much more easily observable by the supervisors than indicators are. Standing behind the operators at a relay switchboard one can practically follow every movement of the subscribers' telephones; a line signal unanswered or a pair of supervisory signals unattended to glare insistently until the operations demanded are performed. The supervisor's attention is instantly called to any unusual rush of calls or to any difficulty or delay.

The constant observation of the traffic is the measure which has contributed most to the effective use of modern apparatus and to the attainment of a high standard of efficiency and accuracy in the operation of a large daily volume of telephone traffic. It is only by making continuous tests on a certain proportion of the daily traffic, noting not only the time of every step, but the method and manner of conducting every part of the operation, that sufficient information can be gained of operations involving so much detail to enable defective methods of operating to be eliminated or checked, and suggestions to be evolved tending to a general increase of efficiency.

Some idea of the complexity of telephone traffic may be had from the fact that the form for recording these service observations contains 42 columns, each with its appropriate heading. An entry in each of these columns would not be made for a single call, but the test of one connection might require notes in a fair proportion of the columns, and even if but very few entries are made, each test or series of observations contributes its quota of information relative to the speed, the accuracy and the general efficiency of the service. To set all these observations out on a diagram would hardly be interesting, and I will only say that the observations give the time, in seconds and fifths, of every step of the connection, whether effective or ineffective, and if ineffective from what cause—engaged, don't answer, cut-off, wrong number, subscriber left instrument, etc. the mistakes and omissions of the operator or the subscriber, for even telephone subscribers are known sometimes to make mistakes—and in short, every ordinary vicissitude that the telephone connection is subject to. The information gained by a large number of tests of this kind, in which observation is made of every detail in the brief history of the telephone connection, is of enormous value in bringing to light the weak spots in the service, whether they may be due to defects or faults in the plant, to slowness, inattention, lack of operation or lack of method, or erroneous methods on the part of the operators I hardly like to hint that there may be sometimes lack of method or erroneous methods on the part of the users of the service who may thus contribute to the errors and delays which sometimes occur in the daily stream of telephone traffic; but if there be, continuous service observations will reveal them and measures may then be taken to suggest such reforms as seem advisable.

To secure speedy and accurate operation of the vast volume of traffic which flows daily through a large telephone system requires first, that the apparatus used have signals of definite meaning, that the working of the apparatus be largely automatic and that the apparatus be of uniform type throughout the system; second, that the operators be thoroughly trained in the manipulation of the apparatus and in the methods of dealing with all varieties of calls before being intrusted with the conduct of actual traffic; third, that the operators be continuously trained to active co-operation with each other, so as to produce general efficiency, and to accuracy and method in every detail; fourth, that a constant study be maintained of the actual conduct of the traffic, directed to the improvement of the standards of accuracy and speed.

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DUPLICATION OF ELECTRICAL APPARATUS TO SECURE RELIABILITY OF SERVICE.*

BY H. W. BUCK.

The question of the proper reserve in an electrical installation is a problem that, like many engineering problems, must be settled largely upon a basis of cost. It is nearly always a question involving a balance between a power company's obligation to its customers and the obligation to its stockholders. From the standpoint of the consumer the more reserve the surer will be his supply of power. On the other hand, to the power company's stockholders the less the investment in reserve the larger the dividends, unless the reserve has been cut down to a point where the power company's reputation is endangered by interruptions to service. The question is purely a practical one and no definite laws can be enunciated, nor can any curves be plotted which will indicate the proper amount of reserve to be installed under various conditions. The decision in each case must be based on intimate knowledge of the local conditions and requirements of the particular installation in question. All that will be attempted in this paper will be a discussion of the general principles involved.

For purposes of discussion electrical reserves may be divided into several classes of apparatus, each governed by different conditions. These classes are:

1. Generating units.

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*Abstract of a paper presented at the 197th meeting of the American Institute of Electrical Engineers New York, May 6, 1905.

2. Generating plant switchboard.
3. Generating plant transformers.
4. Underground distribution system.
5. Overhead lines.
6. Sub-station apparatus.
7. Apparatus on premises of individual customers.

Reserve apparatus applicable to the above can again be divided into two classes.

a. Actual apparatus installed complete ready for service.
b. Reserve parts held in storeroom.

GENERATING UNITS.

There is no place in a power system where reserve apparatus is so important as in the generating station. In the writer's opinion the following conditions should be observed in every large generating plant where continuous service is demanded; the maximum overload capacity of the generators normally operating on the bus-bars should be such that at any time and under any conditions of load any one on the generators can be instantly disconnected from the bus-bars without necessitating a reduction of station load or causing a serious momentary drop of pressure. If any trouble, either incipient or actual, should then develop in one of the generating units, the unit can be immediately put out of service without waiting to start up another machine to take its place. Furthermore, there should, if possible, be one unit held as absolute reserve which need not be operated except as a substitute. This enables any one generator to be out of service for repairs, even during load-peaks. The size of generating unit selected for an installation has an important bearing on the question of reserve. The larger the unit the lower the cost of the plant per kilowatt, but, by necessity, the larger will be the investment in the idle reserve machinery. The proper relation can only be determined by a study of the local conditions under which the plant is to operate.

A station operated by steam-turbines or by water power has certain advantages in reserve conditions. With steam turbo-generators, on account of the comparatively high part-load efficiency of the steam-turbine, all the units installed in the plant, including the reserves, can be kept in operation on the bus-bars at all times without serious sacrifice in steam economy due to the part load on each unit. This enables a generator to be quickly disconnected from the bus-bars at any time without overloading the remainder, or causing a serious drop in pressure. This condition also obtains in a water power plant since the additional use of water caused by the continuous operation of the reserve units has only little effect on the cost of producing the power. With a reciprocating engine, however, each unit must be operated as far as possible at exactly the full-load point on account of the economy required in steam consumption. This prevents obtaining the full utility of the reserve machines.

The exciters in an alternating current generating station are of course the heart of the entire system, and the most careful provision should be made to insure continuity of service therefrom. Since the cost of the exciters is in every case only a small proportion of the cost of the plant there is little excuse for not installing ample reserves in connection with the exciter equipment.

Of equal importance with the complete reserve machinery installed is the stock of reserve parts held in the storeroom. There should be kept on hand at all times ready for immediate use a complete outfit of the parts of the prime-movers and generators which are most likely to wear out or break down.

GENERATING PLANT SWITCHBOARD.

Under this heading might be included all of the electrical equipment of the station from the terminals of the generators to the point where the outgoing feeders leave the power-house. This will necessarily involve a large amount of cable as well as all of the switch equipment and controlling appliances. Here the question of reserve is almost wholly a storeroom proposition. In the writer's opinion, the actual installation of duplicate cables in the station wiring and duplicate switches, controlling devices, etc., should be avoided as far as possible, as tending to occupy too much valuable space and to complicate the organization of this vital part of the plant. There should, however, be kept on hand, preferably in the power-house itself, the fullest inventory of switch parts which are liable to injury, and full lengths of all sizes of cable used in the installation. The duplication of bus-bars is of course quite necessary in a generating plant, but more for reasons of flexibility of operation than for reserve. Bus-bar installations as now constructed are less liable to breakdown than almost any part of an electrical system. A great deal can be accomplished toward reserve in the case of switchboard equipment by keeping on hand a suitable outfit of jumpers with proper terminals soldered on to use for emergency connections to temporarily transfer feeder or generator leads from one switch to another.

GENERATING PLANT TRANSFORMERS.

Many of the considerations involved in the generating units enter into the question of duplication for reserve in a transformer equipment. Here also in regard to the size of unit selected a proper balance must be established between the saving in cost per kilowatt by the adoption of large units and the saving in investment in reserve transformers by the installation of smaller ones. Another important question has recently been brought up in connection with transformer plants by the introduction of one polyphase transformer as a substitute for two or three single-phase transformers for a bank. A polyphase transformer occupies less space and costs less than a bank of single-phase transformers, but when reserve is considered it is not so good. If a bank of separate single-phase transformers breaks down the trouble is not likely to involve more than one of the component transformers and this can be replaced by a small kilowatt reserve. If, however, a polyphase transformer breaks down, capacity equal to its full polyphase rating is put out of service.

In the writer's opinion all important transformer stations should have a complete spare bank which can be shut down at any time without overloading the remaining-transformers, and in addition one single-phase transformer should be held in stock to make good any bank in case one of the component transformers should break down.

OVERHEAD DISTRIBUTION.

If there is a single element in an electrical system where trouble is sure to develop sooner or later it is on the overhead lines, and the higher the pressure the more likely is the trouble to occur. This is so because the overhead lines are subjected to influences over which the power company has no control. These influences are principally lightning, general abnormal weather conditions, malicious interference, and accidental interference caused by the contact of other companies' wires during construction work. For these reasons it is practically out of the question to attempt to maintain a continuous power service over a single-circuit overhead line. There should always be enough circuits installed so that at least one can always be shut down without necessitating a reduction in load. This is especially true in the case of high-pressure lines. In low-pressure systems of 2,300 volts or less it is nearly always possible to replace insulators and do other work on the line while it is "alive," but at higher pressures this should not be allowed if there is any regard for human life. In many plants where important interests are dependent upon the power transmitted the matter of duplication should be carried beyond the circuits and reserve pole-lines installed. Carried to its limit without regard to cost, the ideal condition would be a number of single circuits each installed on a single pole-line and each line following a different route. With this arrangement lightning would not be likely to disturb more than one line at a given time, and a complete shut-down from malicious interference involving all the lines, would be very improbable. The cost, however, in such a separation of lines would in most cases be prohibitive on account of purchase of right of way, patrolling, etc.

UNDERGROUND DISTRIBUTION.

When trouble develops on an overhead line the location of the breakdown can usually be quickly found by patrol and repairs made without delay. In an ungerground feeder, however, the conditions are radically different. Breakdowns are difficult to locate and when found repairs frequently occupy many hours on account of the necessity for pulling out the defective cable from the ducts, putting in new cable and resplicing. Duplicate or triplicate cables should always be installed where important service is involved. This obligation is conceded by most engineers, and spare underground cables are usually installed. The installation, however, is apt to be carried out in such a way that the security of the reserve cables is impaired. Underground conduits as now generally constructed consist of a congested mass of ducts grouped in such a way that in the manholes the cables are crowded closely together and all in constant danger of destruction in case of a violent short circuit in the manhole. There is little value in installing spare cables when they are liable to be damaged at just the time when they are most urgently required. Such risk can only be obviated by constructing electrical conduits in such a way that the cables can be separated in the manholes by short-circuit proof barriers. Preferably, whenever possible, duplicate conduits should be constructed on opposite sides of the street or, still better, laid through different streets. Only by such precautions can the full benefit of the reserve cables be insured.

SUB-STATION APPARATUS.

The general considerations which apply to generating-plant reserves also apply to outlying sub-stations but in a less degree, for the complete shut-down of a sub-station involves only a portion of the power system. Farther out on the power network to the plants of individual customers, where the transformer or other apparatus is supplied by the power company, no reserve seems necessary under the ordinary obligations of such cases. If a breakdown occurs only the individual is inconvenienced, and therefore the risk is usually justified.

AMERICAN INSTITUTE'S MEETING.

It is expected that there will be a large attendance at the meeting of the American Institute of Electrical Engineers to be held at Asheville, N. C., June 19–23.

Arrangements have been made with the Southeastern Passenger Association, in whose territory Asheville is located, for a one and one-third round trip fare on the certificate plan. It is probable that the Southern Railway Company will allow the members of the Institute a one-fair rate over its lines.

The convention headquarters will be at the Battery Park Hotel, Asheville, where there is a suitable hall for the reading of papers. The hotel accommodations are excellent. The rates at this hotel will be from $3.50 to $4.50 per day, on the American plan. Cheaper accommodations may be had at other hotels.

A $350,000,000 "Sleeper."

The identity of the persons connected with the Anti-Monopoly Light & Power Company of New York was made public Friday, when the incorporation papers were filed. The company was incorporated Wednesday at Albany, and immediately after a mortgage was executed covering all right and title in a half interest in its franchise for $350,000,000. The company is capitalized at $100,000, and its franchise has lain dormant for 18 years.

Albert G. Stephenson, vice-president of the "anti-monopoly" company, said to a reporter that the reason for getting the mortgage of $350,000,000, was that the company wanted to have money in store to enlarge the business at any time that it became necessary. A man in this company, he said, has been mixed up in the lighting of nearly half the cities of the United States.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MAY 23, 1905.

Electric Railways and Appliances.

790,434. Trolley. John B. Humphrey, Louisville, Ky., assignor of one-half to Sam B. Crowder, same place. Filed Sept. 21, 1904.

790,538. Protected-Third-Rail Electric-Railway System. Henry A Thomsen, New York City. Filed Feb. 12, 1904.

790,670. Steam or Electric Railway Cross-tie Made of Concrete. Augustus W. Wolfe, Gladstone, Mich. Filed Nov. 16, 1903.

Electric Lights and Appliances.

790,472. System of Distribution for Multiple-Glower Lamps. Alexander J. Wurts, Pittsburg, Pa., assignor to George Westinghouse. Filed Nov 9, 1900.

790,499. Electric Lamp. Marshall W. Hanks, Pittsburg, Pa., assignor to George Westinghouse. Filed July 14, 1900.

790,525. Electric Glower-Lamp. Henry N. Potter, Gottingen, Germany, assignor to George Westinghouse, Pittsburg, Pa. Filed Aug. 14, 1899.

790,551. Electric Lamp. Edward Bennett, Pittsburg, Pa., assignor to George Westinghouse. Filed Sept. 26, 1903.

Electrical Machinery and Apparatus.

790,362. Variable-Speed Power-Transmission Mechanism. Max Guttner, Chemnitz, Germany. Filed July 8, 1904.

790,368. Alternating-Current Machine. Charles W. Johnson, Norwood, O., assignor, by mesne assignments, to the Bullock Electric Company. Filed Oct. 30, 1903.

790,414. Alternating-Current Commutator Machine. Gabriel Winter, Vienna, Austria-Hungary, and Friedrich Eichberg, Berlin, Germany, assignors to the General Electric Company. Filed Aug. 24, 1903.

790,424. Transmitting and Reversing Gear for Motors. William Bruns, New York City. Filed Sept. 24, 1904.

790,471. Dynamo-Electric Machine. Edwin C. Wright, Newport, Ky., assignor to the Bullock Electric Manufacturing Company. Filed Sept. 30, 1904.

790,475. Dynamo-Electric Machine. Bernard A. Behrend, Norwood, O., assignor to the Bullock Electric Manufacturing Company. Filed Sept. 19, 1904.

790,541. Controller for Electric Motors. Walter J. Warder, Jr., Chicago, Ill., assignor to the Western Electric Company. Filed Sept. 26, 1904.

790,569. Electric Machine. Albert F. Hemingway, Chicago, Ill., assignor of one-half to John R. Markle, same place. Filed Aug. 15, 1904.

790,768. Electric Stop-Motion for Textile Machinery. Joseph B. Whitney, Brooklyn, N. Y. Filed Aug. 9 1902.

Telephones and Telephone Apparatus.

790,428. Telephone-Trunsmitter. Harry M. Gall, Buffalo, N. Y. Filed July 7, 1904.

790,548. Annunciator. George F. Atwood, New York City, assignor to the Western Electric Company Chicago, Ill. Filed June 18, 1904.

790,550. Party-Line Telephone. Henry M. Bascom, Brooklyn, N. Y., assignor to John F. Hemenway, New York City. Filed Sept. 12, 1904.

790,684. Telephone Call Attachment. Joseph Harveston and John O. Mudgett, Santa Cruz, Cal. Filed Dec. 16, 1904.

790,740. Desk Attachment for Portable Telephones. Edmund Ocumpaugh, Rochester, N. Y., assignor to the Defiance Machine Company, same place. Filed Dec. 26, 1903.

790,812. Electric Telephone-Switch. George F. Archer, New York City. Filed Oct. 15, 1903.

790,814. Multiple Switch for Telephones. Charles V. Beaver, Anita, Ia. Filed Dec. 7, 1901.

790,854. Telephone System. John G. Roberts, Evanston Ill., assignor to the Kellogg Switchboard & Supply Company, Chicago, Ill. Continuation of renewed application filed Feb. 23, 1901. This application filed May 8, 1902.

Miscellaneous.

790,303. Burglar-Alarm. John E. Liess, Chicago, Ill. Filed Nov. 13, 1903.

790,309. Electrical Veterinary Appliance. Albert Paxton, Montpelier, Ind. Filed Sept. 15, 1904.

790,502. Battery Solution. Frank M. Holmes, Marionville, Mo., assignor to Richard H. Stevens, trustee, Clayton, Mo. Filed Jan. 25, 1904.

790,581. Inductance and Induction Coil for Electrical Apparatus. Dimmitt R. Lovejoy, Niagara Falls, N. Y., assignor to the Atmospheric Products Company, same place. Filed Aug. 19, 1903.

790,747. Electroplating Apparatus. Charles T. Pratt, Frankfort, N. Y., assignor to the Pratt Chuck Company, same place. Filed Oct. 3, 1903.

790,753. Electric Clock System. William A. Roberts and Edward T. Robinson, St. Louis, Mo., assignors of one-third to Edward I. Robinson, same place. Filed March 19, 1904.

790,819. Means for Controlling Electric Currents. Gerald J. Dorman, Brooklyn, N. Y., assignor to the Consolidated Railway Electric Lighting & Equipment Company. Filed Oct. 16, 1902.

790,866. Battery. William C. Banks, New York City. Original application filed April 11, 1901. Divided and this application filed Jan. 5, 1905.

790,870. Thermostat. Harvey H. Blackman, Ithaca, N. Y., assignor to the Cornell Incubator Manufacturing Company, same place. Filed June 10, 1904.

THE TELEPHONE WORLD.

Telephone Company Declares Dividends.

At a monthly meeting of the directors of the Columbus, O., Citizens' Telephone Company, the regular quarterly dividend of 1 per cent. on the common stock of $750,000 was declared.

According to the reports received the company is in a flourishing condition and everything is practically in readiness for the installation of the automatic plant, which will take place during June.

Advices have been received by the Columbus people to the effect that vast improvements are to be made by the United States Telephone Company, which controls its long-distance lines, and that by January 1, 1906, the equipment of this company will be unexcelled. The long-distance people expect to have direct communication with the Independent companies of 80 counties in Ohio by October 1 of this year.

The big fight at present is for an entrance into Hamilton County and the Independent people claim that they will be in Cincinnati shortly.

The Independent & Interstate Telephone Company is slowly but surely establishing its system in Peoria, Ill. Two weeks ago 300 telephones were "cut in" for use, and every day since that time 50 to 70 instruments have been reported "in order." The work is proceeding as rapidly as is possible under all circumstances.

Attorney W. A. Medsker, of Cambridge City, Ind., representing the Milton Co-operative Telephone Company, has procured the charter under which it will be fully organized for business. The capital stock of the company is now $10,000.

The Albion-Loretto, Neb., Telephone Company, an Independent concern, has been organized and has filed articles of incorporation with the Secretary of State. The capital stock is given at $5,000. W. F. Riley and F. F. Willott head the long list of incorporators and stockholders.

The Sandusky, O., Telephone Company has inaugurated a telephone system at a rate of one cent per call. A great many slot machines have been in use in that city, and contracts are now being signed by almost every one who has in any way any use for the system.

A material reduction in rates will be made by the Providence, R. I., Telephone Company in that city on June 1. The rates for the entire system, including Attleboro, Woonsocket, Pawtucket, East Greenwich, Warren Bristol and North Attleboro, have not been revised.

A local telephone line has been organized at Junction, N. J., with the following officers: President, Dr. T. B. Fulper: secretary and treasurer, Peter S. Shurts.

A new telephone company has been formed to build a line in Browerville, Minn., and the rural districts. Charles Emerson is secretary.

The Exline Mutual Telephone Company has lately been incorporated in Exline, Ia.

Plans are under way for the installation of a telephone system in Hammonton, N. J.

Telephone Rivalry in Nebraska.

The two telephones in Beatrice, the Nebraska, or Bell, and the Home, are vying with each other to see which can make the most extensions and give the best service. The result is that nearly every neighborhood in the county is reached by 'phone, and it is the intention of the Home company to include within its organization many of the small farmer companies. This will enable the Independent outside companies to get into Beatrice and to the court house, and it will also give the city exchange a wider range in the country.

Telephone Tyranny.

There is strong talk of the organization of a home telephone company in Dickson County, Tenn. The Cumberland Company, which is now operating in that field, charges prohibitive rates and refuses to build lines in the county unless the people provide the material and help construct them, and then pay two prices as 'phone rent. This has incited the farmers to action, and if the Cumberland Company does not show a more liberal spirit toward the rural districts of the county, doubtless a new company will be in the field within the next few months.

The Adirondack Home Telephone Company, which is to be controlled by Albanians, was incorporated lately, with a capital of $150,000 to operate in Franklin, Clinton, St. Lawrence, Jefferson, Lewis and Essex Counties, N. Y. The principal office is to be located in Malone. The directors are Howard Hendrickson, Henry M. Keys, Frank E. Griffin, William B. Harris, Herman J. Dickman and Cornelius J. Crummey, of Albany. It will connect the various cities and villages in the counties mentioned.

The subject of the municipal ownership of the telephone service in Gouverneur, N. Y., is being looked into by a committee of citizens, and the village board has adopted a resolution to the effect that no new franchise for a telephone service in that place be granted until the question of municipal ownership is thoroughly discussed.

The Connecticut Telephone & Electric Company, of Meriden, lately shipped to the Island of Guam 100 telephones and the necessary switchboard equipment, for the United States Government to be used in connecting the various forts and the interior army posts.

The West Kentucky & Tennessee Independent Telephone Association will meet in Mayfield, Ky., June 3.

The People's Telephone Company has completed a pole line from Washingtonville to Strawberry Ridge, Pa.

The work of putting in the new telephone poles between Fond du Lac and Plymouth, Wis., is now completed.

The Edinburg, Ind., Telephone Company has declared a 6 per cent dividend.

The Bluefield, W. Va., Telephone Company has increased its capital stock from $30,000 to $50,000.

Extension of Independent Lines.

Max Hosea, of Columbus, Ind., has been in Jennings County to look after the Independent telephone interests. Mr. Hosea has the management of the North Vernon & Vernon Telephone Companies and the Jennings County Telephone Company. These lines are being extended to all parts of Jennings County, and also lapping over the border of Scott, Jackson, Jefferson, Ripley and Decatur Counties. There are now 700 'phones in operation in these systems in Jennings County, and when the extensions now being built are completed, there will be added to the service over 700 more, making a total of about 1,500 in use in Jennings County and contiguous territory.

Sherman is soon to be made the central exchange for a great telephone system, covering several North Texas counties and giving service to farmers all over the country. The projected lines are being arranged for, and work has already begun on several. It is proposed to give free connection to subscribers at a great number of the exchanges. For instance, Sherman subscribers will be given free communication with Howe, Van Alstyne, McKinney and a number of other small towns, and also with farmers along these lines.

The stockholders of the Mutual Telephone Company, of Shelbyville, Ind., at their monthly meeting instructed their board of directors to let the contracts for an entirely new plant to be constructed in that city. The plant will include an underground system. The 1,120 lines to be laid will have a capacity of 4,800 telephones. A large lot will be purchased and a building erected for the plant, which will include a power plant. The probable cost of the improvements will be $65,000, and the work will be completed by February 1, 1906.

The work of erecting the telephone exchange building for the private automatic system of the New Orleans, La., Naval Station, is progressing well, and the system will be ready for use some time in June, or within the time provided in the contract. The automatic telephone instruments and the selectors have been shipped from the Chicago factory of the Automatic Electric Company, and the installation of them will be commenced about the 1st of June. There will be 25 telephones in the service.

The Freeborn County Rural Telephone Company, of Glenville, Minn., has filed articles of incorporation with the Secretary of State. The capital stock is $10,000, and the incorporators are A. W. Trow, Martin Moe, S. P. Nelson, A. S. Budlong, N. P. Nelson, W. S. Palmer, Walter Knutson and Fred Will.

C. E. Webster, manager of the Independent Telephone Company, of Seattle, Wash., has finished preliminary details on a long distance telephone circuit that is to embrace all the principal points in the Pacific Northwest.

The Eagle Lake, Me., Telephone Company is busy locating a line from Fort Kent, passing through Eagle Lake to Portage Lake.

A local telephone exchange is being put in Torah, Minn.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Aberdeen, S. D.—Sufficient funds have been raised by local business men to insure the installation of a new electric lighting plant. The plant will be built and put in running order by private subscription, and then sold to the city. It will cost at least $40,000.

Anderson, Ind.—Several farmers near here have made a proposition to the city council to have their homes and premises connected with the municipal electric light plant in this city.

Ashburnham, Mass.—The Greene Electric Light & Power Company, incorporated with a capital of $12,000, has the following officers: Charles H. Greene, president; Alonzo A. Carr, treasurer.

Cold Spring, Minn.—The proposition of an electric light and waterworks system for this village has been discussed by the council, and it was decided to submit at an election the proposition of voting $6,000 bonds for the purpose above mentioned.

Deadwood, S. D.—The consolidation of the Lead and Deadwood Electric Light Companies has finally been effected.

Dillon, Mont.—Dr. M. A. Miller, principal stockholder of the Dillon Electric Light & Power Company, has sold his stock to H. W. Turner, manager of the Butte Electric Company.

Fort Valley, Ga.—Bonds for electric lights were recently sold here.

Green Bay, Wis.—The sum of $200,000 will be expended in this city on gas and electric light improvements this year. The stockholders of the old light company voted to dissolve and sell all property to the Green Bay Gas & Electric Company. The officers are William Mainland, of Oshkosh, president; H. Fisk, of this city, secretary.

Groesbeck, Tex.—The Anglin Light Company of this place has been incorporated to supply electric light to the public. Its capital stock is $6,000, and the incorporators are E. Anglin, John Clairman and others.

Hartsville, Ind.—This city is soon to have an electric lighting plant.

Kenton, O.—Kerlin Brothers, of Toledo, have purchased the plant of the Kenton Gas & Electric Company for $128,000. About $50,000 will be spent by them to make the plant one of the best in the State. The city council will give the Kerlins a five-year lighting contract.

Marianna, Fla.—This town contemplates erecting an electric light plant.

Melrose, Minn.—The citizens have voted to issue $26,400 bonds to aid in the introduction of an electric light plant and the extension of the waterworks system.

Memphis, Tenn.—The mayor has appointed a committee from the Legislature council to carry out the provisions of the general assembly, authorizing $1,000,000 bonds to build a municipal electric light plant.

Parsons, Tenn.—A few men of this place met recently and decided to put in an electric light system. The principal stockholders are L. A. Rains, J. W. Fuller, Houston Partin, C. F. Abston and the Parsons Marble & Granite Works.

Potsdam, N. Y.—The trustees of this village have decided to offer for sale bonds to the amount of $40,000, the proceeds to be used to construct, equip and maintain a plant to furnish the village and its people with electricity, according to the terms proposed at a recent election.

Princeton, Ill.—It is reported that J. D. Dennis will install an electric light plant in his building here.

Rathdrum, Idaho.—Arrangements have been completed by which an electric light company will be organized to install a system here, the plant to be in operation within 90 days.

Savannah, Ga.—The Savannah Electric Company will double its lighting capacity by installing a steam turbine valued at $18,500.

Sioux City, Ia.—The Sioux City Gas & Electric Light Company will expend $100,000 for improvements.

South St. Paul, Minn.—The city council has granted a franchise to the South St. Paul Heat, Light & Power Company for the purpose of constructing an electric light system and power to manufacture plants.

Stoughton, Wis.—At a recent meeting of the city council, it was decided to purchase the electric light plant from the Electric Light & Power Company at $12,000.

Sturgeon, Mo.—This town has let the contract for an electric light plant.

Syracuse, N. Y.—The Hoosick Falls Electric Light & Transmission Company is to do business in Onondaga and other counties. Its capital stock is $150,000.

Tecumseh, Neb.—The Tecumseh electric light committee has prepared a report to submit to the next meeting of the city council, which it is said asks for improved equipment at the power house.

Ventura, Cal.—This city has voted to issue bonds in the sum of $100,000 for waterworks, and $25,00 for an electric light plant.

White Plains, N. Y.—The Homans Light, Heat & Power Company, of this place, has been formed to supply gas, electricity and steam throughout the State. Its capital stock is $50,000, and directors, R. B. Marten, W. P. Homans and M. S. Watts, of New York City.

STREET RAILWAYS.

Asbury Park, N. J.—From reliable sources it was lately stated here that the Central Railroad of New Jersey and the Pennsylvania, operating the New York & Long Branch Railroad, in a short time will substitute electric engines as a motive power on the road.

Chattanooga, Tenn.—The Chattanooga Electric & Rapid Transit Street Railway Company will make extensive improvements this summer.

Chickasha, I. T.—The city council has granted a franchise to the Chickasha Transit Company to build and operate an electric street railway system.

Chouteau, Mont.—An electric franchise has been granted to Dr. E. Crutcher to construct electric lines over the roads of Teton County.

Council Bluffs, Ia.—Capitalists of this city are behind the scheme to build an electric road to Oakland or Carsons, running past Treynor and extending to Des Moines.

Evansville, Ind.—According to the statement of H. W. Richardson, secretary of the Evansville & Henderson Traction Company, the new road will be in operation by September 1.

Kansas City, Mo.—An electric line from this city to St. Joseph on the Missouri side of the river, with spurs across to Leavenworth, is under consideration by a party of Cleveland capitalists.

Marcellus, N. Y.—The Marcellus & Otisco Lake Railway Company is a reorganization of the Marcellus Electric Raiload Company. Its capital stock is $200,000, and directors, G. M. Brill, Merion, Pa.; S. S. Marvin, Bryn Mawr, Pa.; H. H. Bayne, New Brighton, S. I.

Oakfield, N. Y.—The village board has signed a contract with the United States Gypsum Company for lighting the streets of this place with electricity.

Rochester, N. Y.—Offices have been established in this city by the Rochester & Southern Electric Company which has been formed for the purpose of building an electric railway between this city and Elmira, with several branch lines. George A. Engert of New York, is in charge of the company's affairs here.

Toronto, Ont.—The Ontario Government is asking for power to extend the Temiskaming to the Grand Pacific, and to operate the road by electricity.

Webster, Mass.—The territory between this town and Southbridge, it is said, will soon be looked over by an engineer with the view to forming a corporation to construct an electric railway to directly connect the two towns.

POWER PLANTS.

Buffalo. N. Y.—The Niagara Gorge Power Company, of this city, has been capitalized at $2,000,000. J. T. Jones, J. A. Jones, R. E. Powers and H. P. Bissell, are the directors.

Chattanooga, Tenn.—The proposition of C. E. James and J. C. Guild to erect an electric power plant on the Tennessee River, at a cost of $3,000,000, has received the cordial and hearty support of this city.

Langford, Pa.—The Lehigh Coal & Navigation Company in Panther Creek Valley contemplates erecting a large electrical plant here.

Reno, Cal.—A new electric power plant will be constructed in this city at a cost of $50,000.

Sault Ste Marie, Mich.—The Edison Soo Electrical Company has executed a mortgage for $500,000 to secure the bond issue, the proceeds from which will be used in extending the power plant of the concern.

Winnipeg, Man.—The organization of a strong company that has been formed to develop electric energy from Winnipeg River water power is about completed, and it is expected that actual work will be under way early in June.

Youngstown, O.—Plans are to be made to greatly enlarge the power plant of the Youngstown Consolidated Gas & Electric Company on North avenue.

BIDS WANTED.

Meaford, Ont.—Bids will be received until 2 P.M. June 5, for electrically lighting the streets of this town. K. G. Clarke may be addressed.

Wilmington, N. C.—Sealed bids will be received until June 8 for suppling this city, for the year ending May 31, 1906, with electricity for lighting, etc. Address A. M. Waddell mayor

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15@15⅛c.; Lake 15@15⅛c.; casting, 14¾@14⅞c.

The Bryant Electric Company of Bridgeport, Conn., has filed notice of increase of its capital stock from $125,000 to $2,500,000.

The control of the Springfield (Mass.) Street Railway Company was formally passed into the New Haven Railroad management Friday afternoon.

The Lockport Gas & Electric Light Company of Lockport, N. Y., has filed with the Secretary of State a certificate of increase of capital from $150,000 to $300,000.

The Holland Electric Power Company of New York was incorporated at Albany on Saturday with a capital of $20,000. The directors are G. G. Cooper, R. U. Conger and Goodwin Fitch, of New York.

The American Railways Company, Philadelphia, has reported for the first ten months of the fiscal year gross earnings of $1,205,994, an increase of $53,602, or 4.5 per cent., over those for the same period last year.

Many brokers in the financial district are asking for an annual report of the Westinghouse Electric Company and proclaiming that while the General Electric publishes full annual statements, the Westinghouse people are keeping silent.

An action was begun Friday in the United States Circuit Court by the Westinghouse Electric & Manufacturing Company against the Manhattan Railway Company of New York to recover $371,475, claimed as due the plaintiff on contracts with the defendant.

The April report of the Montreal Street Railway Company, just published, shows a comfortable gain in net earnings over last year. The surplus account is increased by about $15,000. The expense account for the month amounts to practically the same as in the same month last year.

The Hydrotherm Electrical Company was incorporated Friday in New Jersey with a capital of $1,000,000. The incorporators are L. D. Winton, E. M. Treat, Charles F. Bates, Robert E. Williams, S. M. Heil, Edward Sills, C. T. Westlake and T. T. Price, all of Jersey City, The company is to manufacture and deal in electrical machinery.

Steam roads out of Columbus, O., have taken concerted action to compete with the electric roads out of that city. All but the Pennsylvania Company have agreed to meet the rates of the interurban to competing points. The Pennsylvania officials decided that it would not be profitable to fight the interurbans.

In Metropolitan circles in New York there is some tendency to concede that the Supreme Court of the United States will sustain the constitutionality of the franchise tax law, but though the principle of the measure will then be settled beyond dispute, there is the large question of offsets, the amount and nature of which will be the cause of additional litigation.

N. W. Halsey & Co. of New York are offering $2,500,000 first mortgage 5 per cent. gold bonds of the West Penn Railways Company. The property upon which these bonds are a lease consists of 98 miles of interurban electric lines of heavy steam railway construction, serving a population of over 200,000 in the well-known Connellsville coal and coke district adjacent to Pittsburg. They are also a lien upon an electric lighting system which supplies 34 communities, including five cities.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price May 27
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	202
Manhattan Elevated Railway	162⅞
Metropolitan Street Railway	115⅛
Metropolitan Securities	75⅝
Ninth Avenue	197
Third Avenue	126
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	57⅞
Brooklyn City Railway	240
New Orleans Railway	4¼
Public Service Corporation (New Jersey)	121
Philadelphia.	
Consolidated Traction of New Jersey	83¼
Philadelphia Traction	100⅛
Union Traction	62⅞
Boston.	
Boston Elevated	157
Massachusetts Electric Companies, com	16¼
do. do. do. pref.	66
West End Street, com	97
do. do. do. pref.	116
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	6⅝
do. do. pref.	45
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	13⅝
do. pref.	51⅞
Electric Boat, com	37
do. do. pref.	75
Electric Lead Reduction	¼
Electric Vehicle, com	12⅛
do. do. pref.	20
Westinghouse, com	165
do. pref.	190
General Electric	170
Boston.	
Edison Electric Illuminating	247
General Electric	170
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	155
National Carbon, com	62
do. do. pref.	116
Philadelphia.	
Electric Company of America	11⅛
Electric Storage Battery, com	78
do. do. do. pref.	78
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	137⅛
Western Telephone Company	18
New England Telephone Company	138⅛
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210¼
Mexican Telephone Company	1⅛
New York & New Jersey Telephone Company	172⅛
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92⅛
Chicago Telephone Company	130
MISCELLANEOUS STOCKS.	
Otis Elevator Company	52
Consolidated Car Heating	64
Standard Underground Cable	200

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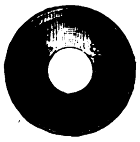

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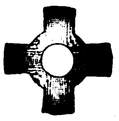

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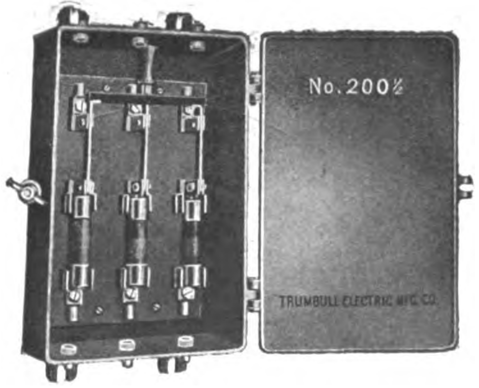

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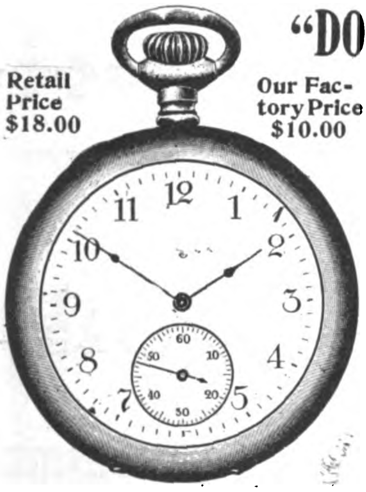

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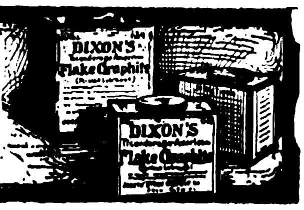

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EDITORIAL NOTES.

The National Electric Light Convention. The twenty-eighth convention of the National Electric Light Association is now in full swing at Denver. The programme this year is a most elaborate one and if successfully carried out should make this year's convention by far the most instructive and incidentally entertaining of any held heretofore.

Nothing escapes criticism in this world and the locality selected for the holding of this year's convention is no exception to the rule. Many Eastern members of the association thought it too far West, but on the other hand, the far Western members are entitled to some consideration and the locality selected should enable them to attend without having to travel across the whole Continent as they have several times been obliged to do.

The numerous papers which will be read at this gathering are invariably on subjects of vital interest to the industry, as may be gathered by a glance at the programme, which will be found on page 315 of this issue. The volume on wrinkles—for in reality it is a volume—edited by Mr. H. C. Abell, is a feature of quite recent origin which cannot be too highly commended. There are invariably hints in these short descriptions and explanations which are simply not attainable in any other way.

The many reports to be made this year we are confident will prove of great interest to all engaged in the electric light business.

The social and entertainment features of this convention are decidedly attractive, the trip to Colorado Springs affording the delegates an opportunity of visiting Pike's Peak and other points of interest in the immediate neighborhood.

The Ruling Power in Battle. Warfare has passed through many stages of transition, and in its development to what we, with unconscious satire, call civilized warfare, it has budded into a new growth. It has emulated the examples shown by nature in her methods of protectiveness. The creature with a shell on its back, or even the mollusk, living entirely within its shell, is a type of our own martial progressiveness. When we say our own, it is to be understood that the expression embraces all history. Man originally settled his arguments with his bare hands and teeth or with a club. He graduated from this to a weapon with a cutting edge. He then protected himself with a carapace, like the turtle. This was his shield and saved his body from missiles and blows.

The bow and arrow and the large war canoe or wooden vessel is found in early England, France, Germany and Greece. Other countries probably advanced along the same lines, including the Oriental nations. Darius, the Persian king, with a million men at his back marched against the Greeks. The bows and arrows of his followers fell harmlessly against the great shields of these ancient warriors. Authentic records show how Darius and his myriads were destroyed by less than a hundred thousand men.

Thus history repeats itself. Warfare no longer consists of numbers. Its successes cannot be measured by officers. The fundamental force engaged in action in great naval batteries is intelligence, not that the word can be used carelessly. It is to be applied specifically. Trained or specialized intelligence is the phrase. This, in conjunction with the operation of vast steel shells and devices to project explosives and masses of metal through the air, constitutes the ruling power in battle. But, although the steel becomes harder and thicker and the projectiles and explosives more terrible in their destructiveness; their effectiveness is governed by other influences of which we must speak. This influence is not hard to imagine as it is found operating on every side in civilized centers.

Protection at night is found in the powerful electric eye of the warship which sweeps the horizon. The signal for advance or recession is flashed through the invisible ether by Hertzian waves. The great guns are raised, lowered and set off by electrical energy, and finally the ship's light is operated by the same means. The scorpion of the seas, the torpedo boat, is inmeshed by the same influence, and the submarine, when pursuing its deadly vocation under the ocean, is driven and controlled by the force of electricity. Thus it is evident that a nervous system operates any great galaxy of battleships. A nervous system through which electricity sends its marvelous manifestations. The hand that touches the buttons must be animated by the fire of genius, but its thought to-day is best crystallized by the web electricity has spun.

* * *

The Giant Generator.

Twenty years or so ago the products of electrical enterprise were very crude and limited. It can be well remembered by some how a plumbing system was attached to the early jumbo dynamos. This was the only effective way of keeping them cool. They were then, as a witty expert explains, "not dynamos, but machines for producing electricity." Scientific knowledge was so rare that even the mechanical crystallization of the things best known stood on the ragged edge of failure. Arc lamps, incandescent lamps, dynamos and motors were purely experimental in character. Sparking at the brushes was considered a healthy sign, and the continuous though uneven light of an arc lamp a distinct victory. Retrospection shows how much things have changed since then. It points out the advance in the fields that mark the most intense displays of progress and energy. It shows how the incandescent lamp has reached a high state of perfection, the arc lamp a degree of regulation that leaves no criticism, the motor an efficiency that has established it in the majority of commercial and industrial projects for all time, and the dynamo a position in the nation's development that makes its utilization indispensable.

The last is but a sign of what is to come. Larger and larger each year the generator has grown, until now its size is becoming that of a behemoth. The giant generator is the term applied, not because it has reached its final stage of growth, but through the enormous dimensions of itself and the great functions it performs. The kilowatts capacity are being increased at so rapid a rate that little doubt now remains of what the future will yield.

The electric light and power station of a decade hence will be equipped with the most modern of appliances. Not the least of these will be generators of a capacity that will overshadow those now in use.

Valid objections to great size in this case cannot exist. Great generators offer every advantage in the consideration of large power enterprises. For this reason the shops have tasks before them that will alter the architectural and electrical conceptions of our engineers as few things in this last period of our progress.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The annual meeting of the National Electrical Trades' Association will be held on June 23 at La Corona Hotel, Montreal.

In the minds of some close observers there is still considerable doubt about the ability of the Mayor of Chicago to raise the funds to carry out the necessary terms and conditions for the purchase of the traction properties of that city.

It is authoritatively stated that contracts for fully $5,000,000 of electrical equipment machine and tools have recently been placed in the New York market for Japanese account, shipment to be made with all dispatch.

Owing to the increase in the use of electrical power the London firemen are provided with india-rubber gloves.

The Connecticut Senate has repealed the general railroad law to make it necessary hereafter for steam and trolley companies to secure charters through legislation.

Mr. William Marconi, the wireless telegraph inventor, and Mr. George G. Ward of the Commercial Cable Company sailed for Liverpool on the Campania Saturday afternoon. Mr. Marconi said that he was going to make an effort on the voyage to beat the record made by the wireless operators on the Campania's recent voyage, when for three days in mid-ocean the big ship was in wireless communication with both sides of the Atlantic at the same time. Mr. Marconi hopes to maintain communication with both America and England every day of the voyage.

Conventions attract great crowds in this country. They are local congresses in which politics take a back seat and practice the front. Comparing notes is a great American institution. We owe a large measure of our success in the development of the lighting industry to conventions. The knowledge gleaned in this manner is invaluable. The N. E. L. A. has been one of the most potent influences in this respect. The progress of the fiscal year is in the convention's hands, and all await its conclusions with interest.

An engineering congress will be held at the Lewis and Clark Centennial Exposition, at Portland, Ore., on June 29, 30 and July 1, to which all engineers, architects and other technical men are especially invited.

The length of electric railways in Canada on June 30 last was 767 miles, of which 376 miles were in the province of Ontario, and 254 miles in Quebec.

Trustees of the Massachusetts Institute of Technology are said to have taken options on 3,000,000 feet of land in Watertown, near the Government arsenal, as a possible site for some of its mechanical buildings.

An attempt is to be made to utilize as ore the magnetic sands found on the north shore of the Gulf of St. Lawrence. It is stated that no difficulty is found in getting rid of the titanium and concentrating the sands till they assay 70 per cent. metallic iron; but before they can be utilized some satisfactory process of briquetting them is necessary. Experiments are therefore in progress to this end.

Victorious Japan with her well-earned Banzais takes her successes coolly. Commodore Perry was forced to exercise great tact to enter the Mikado's dominions. To-day the Japanese children celebrate this event in what would be called Perry's Day. Every move of the Russian fleet before they came into vision was sent to Togo by "wireless." Would Marconi's Day be any less appropriate if celebrated as a tribute to one whose genius added so much to their national preservation.

THE NATIONAL ELECTRIC LIGHT CONVENTION.

A larger delegation than was expected left New York on Saturday morning on the special train to attend the convention of the National Electric Light Association at Denver.

Following is the complete programme for the convention:

PROGRAMME.

TUESDAY, JUNE 6—FIRST SESSION, 10 A.M.

Convention Hall, Brown Palace Hotel.

Address of Welcome, the Mayor of Denver.

President's Address, Ernest H. Davis, Williamsport, Pa.

Report, Progress, T. Commerford Martin, New York.

The Paramount Importance of Choosing Standard in Preference to Special Machinery, David Hall, Cincinnati, O.

ERNEST H. DAVIS,
President National Electric Light Association.

Insulation Testing—Apparatus and Methods, C. E. Skinner, Pittsburg, Pa.

TUESDAY, JUNE 6—AFTERNOON SESSION.

Automatic Synchronizing of Generators and Rotaries for Lighting and Power Systems, Paul MacGahan, Pittsburg, Pa.

Notes on Rotary Converters and Motor Generators for Lighting and Power Systems, Louis E. Bogen, Cincinnati, O.

The Organization of Working Forces in Large Power Houses, W. P. Hancock, Boston, Mass.

Report of Committee on Steam Turbines, W. C. L. Eglin, Chairman, Philadelphia, Pa.

Operating Features of the Curtis Steam Turbine, A. H. Kruesi, Schenectady, N. Y.

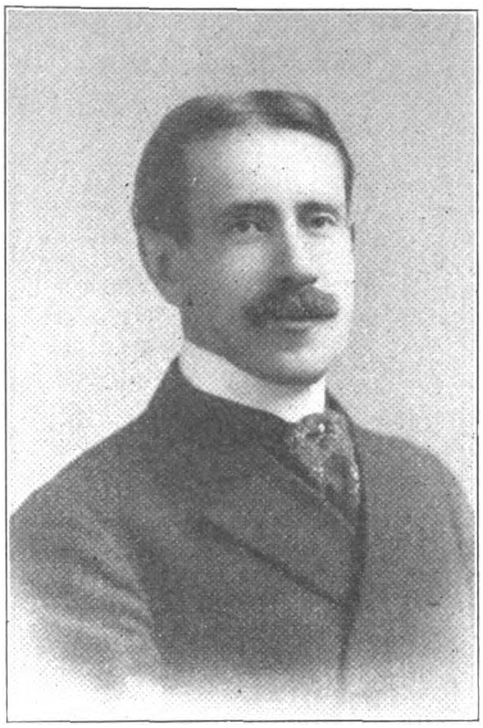
WEDNESDAY, JUNE 7—MORNING SESSION.

Series Alternating Current Motors for Industrial Work, Clarence Renshaw, Pittsburg.

A New Type of Single-Phase Motors for Elevator Work, S. Percy Cole, St. Louis, Mo.

Long Distance High-Tension Transmission in California, John A. Britton, San Francisco.

Report, Present Methods of Protection from Lightning and other Static Disturbances, Alex Dow, Detroit, Mich.



DUDLEY FARRAND,
Secretary and Treasurer of the National Electric Light Association.

The Nernst Lamp—Its Present Performance and Commercial Status, E. R. Roberts, Pittsburg.

The Choice of an Insulated Cable, Wallace S. Clark, Schenectady, N. Y.

WEDNESDAY, JUNE 7—AFTERNOON SESSION.

Some Investigations of Induction Losses, E. P. Dillon, Colorado Springs, Col.

Mercury Arc Rectifiers, P. D. Wagoner, Schenectady, N. Y.

Report, Advertising Methods, Percy Ingalls, Newark, N. J.

Report, Sign and Decorative Lighting, Le Rue Vredenburgh, Boston, Mass.

Free Signs and Flat Rates, C. W. Lee Newark, N. J.

THURSDAY, JUNE 8—MORNING SESSION.

Report, Progress of Electric Heating, James I. Ayer, Boston, Mass.

Report, Purchased Electric Power in Factories, E. W. Lloyd, Chicago.

Report, Committee on District Steam Heating, W. H. Blood, Jr., Chairman, Seattle, Wash.

Wrinkles, H. C. Abell, Editor, New York City.

THURSDAY, JUNE 8—AFTERNOON SESSION.

Report, Committee on Relations with Kindred Organizations, James I. Ayer, Chairman, Boston.

Executive Session.

Report, Committee on Rates and Costs, Charles L. Edgar, Chairman, Boston.

Report, Municipal Ownership, Arthur Williams, New York City.

Question Box, Homer E. Niesz, Editor, Chicago.

THURSDAY, JUNE 8—EVENING SESSION.

Executive Session.

Report of Secretary and Treasurer.

Report of Executive Committee.

Report of Committee on Relations between Manufacturers and Central Station Companies, Henry L. Doherty, Chairman, Denver, Col.

Report of Committee on Standard Rules for Electrical Construction and Operation, Charles L. Edgar, Chairman.

Election of Officers.

General Electric-Westinghouse.

(From the Boston Financial News.

Westinghouse Electric & Manufacturing Company's stock is selling at $165 a share, against $184 on April 6 and $152 on May 20. General Electric is selling at $173 a share, against $192 on March 16 and $169 on May 20. The former paying 10 per cent. returns 6 per cent. to the investor, and the latter paying 8 per cent. is now yielding 4.6 per cent. General Electric, according to the last annual report, published recently, showed 19 per cent. earned on its stock, and from a very reliable source it is understood that Westinghouse is now earning over 20 per cent. for its shares. General Electric at present is earning over 19 per cent. on its shares. Therefore, Westinghouse is earning 13 per cent. on its selling price and General Electric over 11 per cent.

There is no doubt that there is considerable jealousy between the two companies at present. Westinghouse claims to have grown much faster than General Electric and General Electric is said to feel very keenly the fact. The patent agreement between them, however, will keep them from any open break for at least seven years, the remaining time the agreement has to run. It looks now as if General Electric would have an advantage shortly from the expiration of two basic Tesla patents held by Westinghouse, but at the end of two years the famous controller patent of General Electric will expire, and then Westinghouse will be the gainer.

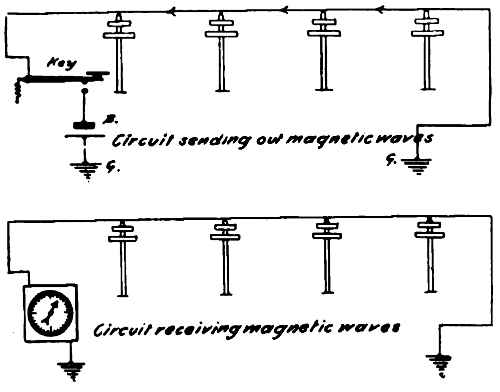
Some well informed Pittsburg people claim that the Westinghouse has been violating its agreements with the General Electric and has been cutting prices severely in order to get new business.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

Telegraphy Without Wires.

Systems of Wireless Telegraphy.—Systems of wireless telegraphy may be classed with reference to the devices employed and the principle put in operation. In either case the operation is dependent upon the radiation of a set of signals representing a certain code. The radiations or waves are etheric, that is, they consist of vibrations of the ether. These waves, or impulses, propagated through the ether are produced by electro-magnetic means. The action transpiring may be classed therefore with respect to the nature of these impulses. Preece of England developed a system of telegraphy which was carried on through the electro-magnetic induction of one line upon another. The distance over which signals could be transmitted was limited and experience has shown that the system inaugurated by the experiments of Dr. Hertz is the only practical system to employ for long distance telegraphing without wires. The credit for the development of this idea, in a manner showing evidence of scientific and engineering genius, belongs to Marconi. The transmission of intelligence without wires over long distances is accomplished by the projection of waves of an electrostatic nature. They emanate from between the discharge knobs of a large induction coil. The principles of electro-magnetic induction are employed in the creation of the high pressure required for this purpose. The discharge of this pressure, under certain propitious conditions, is the process employed for the projection of far-reaching waves. While in many respects similar, yet not entirely different, the sending of a powerful beam of light from a high power search lamp over a distance of some miles, there to operate a peculiar piece of mechanism, is the general plan followed out in wireless telegraphy, so called. The light that is projected is not visible, the waves it represents are different in character from light itself, but it is an ether disturbance and as such falls within the double category of optics and electric waves, of light and electricity.


Key
B.
Circuit sending out magnetic waves
G.
G.
Circuit receiving magnetic waves

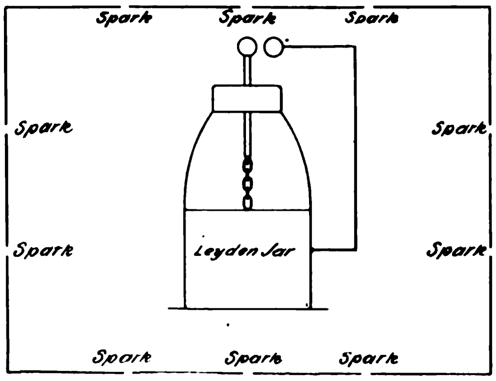
Electro-magnetic induction between two distant wires.

The systems of wireless telegraphy can very properly be included under the headings of the following:

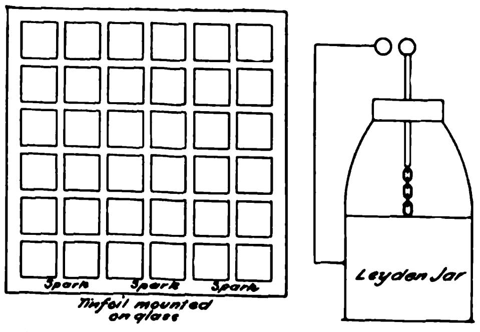
Wireless messages by electro-magnetic induction.

Wireless messages by electrostatic waves.

Application of a Condenser.—By the discharge of a condenser in a room around which was strung wires possessing fine saw cuts, Hertz was able to detect in these saw cuts or gaps delicate sparks. They were the evidence of waves sent out by the condenser when discharged, which swept across these conductors and superinduced in them, or between their ends, a difference of potential. If, instead of employing a wire with fine saw cuts to provide spark gaps, a sheet of tinfoil gummed to a plate of glass is employed and a series of fine knife cuts is made in this, the presence of sparks will be detected in a dark room on observation being made. The principle involved is simply that of employing a detector, as it were, in the form of a device upon which the operation of the waves becomes evident. Thus, two elements must enter into the constitution of a wave signaling outfit built along these lines:



Discharge of a Leyden jar and the effect of its waves upon the fine spark gaps in an adjacent circuit.



Sparks produced between tinfoil parts, separated by fine cuts, by electric waves.

First—The wave-producing device.

Second—A device acted upon by electric waves.

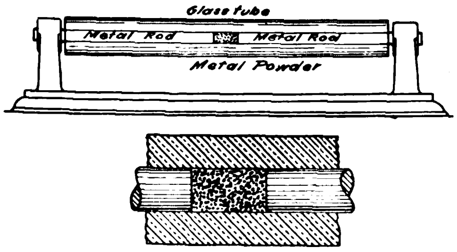
If the possibility existed of sending any other form of wave through the ether to a distant point the same conditions would have to be secured. The projection of the wave would require one type of apparatus, the receiving of the wave influence another type.

The Wave Gives No Signal.—A mistaken conception exists regarding the employment of electric waves for signaling purposes as in wireless or space telegraphy The electric wave does not give the direct signal. This is evidently impossible on account of the exceedingly delicate nature of the manifestation when received.

The function of the electric wave is to be the primary means of setting into operation apparatus which gives signals through the aid of a comparatively powerful current; in other words, it is this last-mentioned current which gives the signal. The means by which the delicate waves are able to impress the apparatus so as to cause a secondary and much emphasized signal can be best understood by reference to the tinfoil coating attached to a glass plate and divided into many parts by fine knife cuts.

A Wave Receiver.—If a few of the segments of tinfoil are connected to a powerful battery and an electric bell is placed in series as well the following condition of affairs is presented. The bell cannot ring no matter how many cells of battery are employed unless their voltage is so great that the current spontaneously leaps or arcs across the knife cuts, but if this condition does not take place the bell can ring if the tinfoil is short-cuited by connecting the tinfoil pieces together again. If neither of these things are done, however, the bell remains silent in series with the battery because of the breaks in the circuit due to cuts in the tinfoil. If any other means can be employed to bridge over these gaps then the bell will ring with great vigor. It is strange to realize the simplicity of the process, how the impact of the waves sent out by the Leyden jar or condenser sets up minute sparks between the tinfoil pieces, as previously stated. Across these sparks, as a bridge, the current of the batteries will rush and the bell will ring. The waves do not supply the electrical energy to ring the bell directly, but indirectly. They must be present to provide the path for the signaling current. It is this principle which is universally employed in a more or less modified form in all modern wireless telegraphic systems. Although it is claimed that no spark is in evidence in the sensitive wave receivers or detectors used in this form of telegraphy, still a change occurs in this device of so remarkable a character that part of a circuit, which before the wave impact occurred possessed so high a resistance that no current could pass; after the wave impact drops, so low in resistance that a relatively powerful current will pass and operate a relay and thus a sounder. The promulgation of an electric wave of a character that will operate upon a wave detector, a wave detector in circuit with a signaling device, and a signaling device which will always remain ready to receive new wave impulses unimpaired defines the requirements of modern wireless telegraphy. The wave detector, so called, which must naturally consist of a device which can form part of an electric circuit and be capable of a high and a low resistance when in service, is given the name of coherer. It performs the same function as the tinfoil sheet with fine knife cuts. It is sensitive to the waves and is thus the most vital part of a wireless system.

The Coherer.—The coherer generally consists of a tube of glass with a metal plug at each end and a pinch of metallic powder between the plugs. Sir Oliver Lodge employed a device of this description in circuit with a galvanometer and a few cells of battery. The theory upon which the application of this invention is based is that of the conductivity of finely granulated conducting substances under certain conditions. According to S. P. Thompson, the following is true in this respect and may be regarded as a valuable piece of information in connection with coherers: "The conduction of *powdered metals* is remarkable. A loose heap of filings scarcely conducts at all, owing to the want of cohesion or to the existence or films of air or dust, but it becomes instantly a good conductor if an electric spark is allowed to occur anywhere within a few yards of it. The resisting films of air are broken down by *minute internal discharges* in the mass. A very slight agitation by tapping at once makes the powder non-conductive."

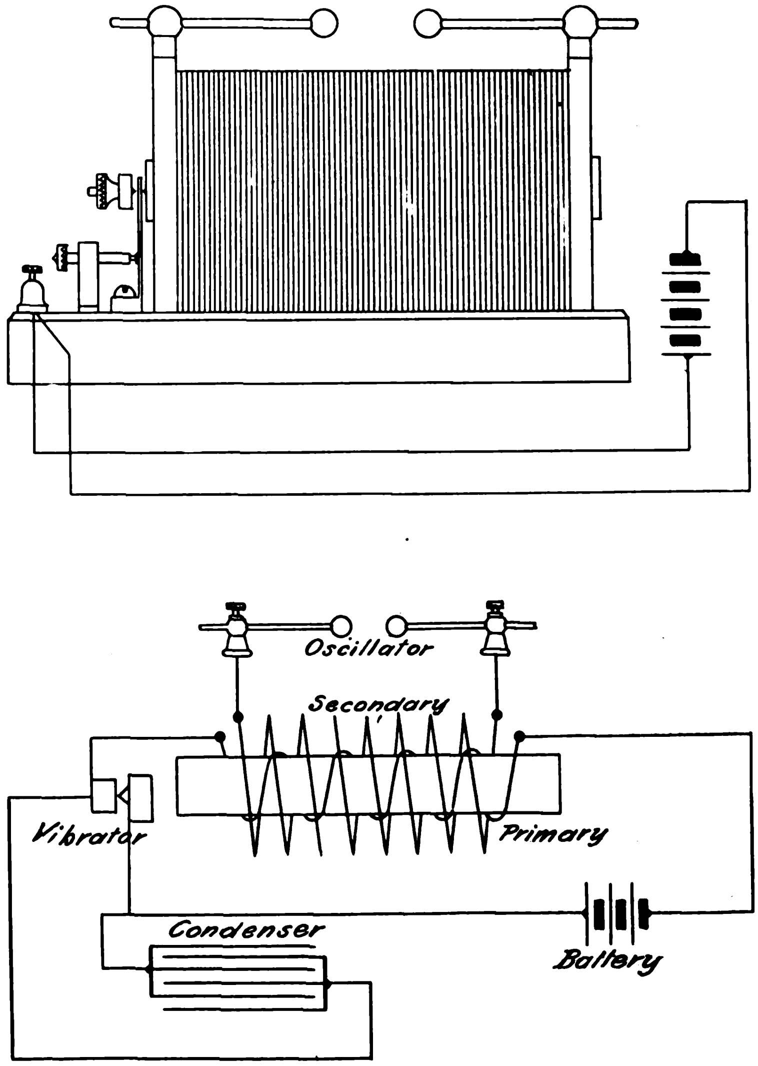


Mounted coherer, also enlarged section showing metallic powder and electrodes.

This most important part of the wireless telegraphic outfit thus consists of a pinch of metallic powder, largely nickel, with a touch of silver, contained within a small glass tube into the ends of which metal pins have been inserted. This device is placed in series with a few cells of battery and a telegraphic relay.

Under normal conditions the relay will not operate, but the presence of electric waves is the immediate cause of its action. They impinge upon the metallic filings and set up between them minute sparks. Over these paths thus provided the battery current instantly passes and actuates the relay. The relay in its turn operates the sounder and thus a signal is transmitted, as it were, almost by a breath.

Decohering.—The relay would persist in remaining in action and the current would continue flowing if some means were not supplied by which the metallic powder in the coherer is disarranged. This process is called decohering and simply consists of tapping the coherer after the receipt of a signal to avoid this difficulty. This is done automatically by means of a little vibrating hammer similar to those found in an electric bell, in fact, a small bell without the gong will perform this function perfectly if so connected up that its hammer just touches the glass tube of the coherer.



Appearance and Connections of a Spark Coil.

The Spark Coil.—The waves are produced by the spark coil according to the common acceptance of the idea. In reality they are produced by the condensers connected to the coil. If the coil itself produced the waves necessary in wireless telegraphy as understood to-day, the system would be electro-magnetic. It is, however, electrostatic, and the waves radiated or directed out into space are caused by the oscillations of electricity taking place in the outside circuit and tinfoil coatings of the condensers connected to the discharge points. Perhaps the discharge terminals are supplied with knobs and thereby dispense with their direct application, but whether this be true or not the waves are the direct result of electrical oscillations set up in the ether by the high tension discharge of the secondary winding.

Parts of a Spark Coil.—The spark coil consists essentially of a primary and secondary winding. In addition to these windings may be found a vibrator, by means of which the current in the primary coil is interrupted, and a condenser. Tabulating these parts with their function will simplify the explanations required:

Parts and Function of the Parts of a Spark Coil.

Primary Coil.—Receives the electrical energy and transforms it into magnetic energy.

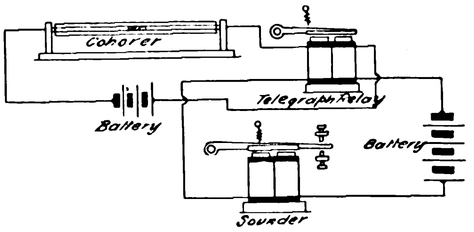
Vibrator.—Interrupts the current entering the primary coil, thus permitting induction to take place between it and the secondary coil.

Secondary Coil.—A coil of fine wire surrounding the primary coil. It receives the magnetic energy of the primary and transforms it by mutual induction into a high pressure current.

Condenser.—This is made in the customary manner of tinfoil and paraffined paper. It is placed in the break of the vibrator to take up the energy that would be otherwise wasted there by self-induction.

This will adequately convey an idea of the meaning of the parts of a spark coil and the co-operation expected of them when in operation.

The Spark Gap.—If the spark gap and the coil and its parts are considered, it becomes evident that the size and number of waves per second are dependent upon these conditions. A large bell produces slower and more sonorous vibrations than a small bell. In the same sense the spark gap of an oscillatory circuit will influence the character of the waves produced. It is stated that the wave length of an oscillator provided with very small knobs is twice the length of the oscillator circuit.



The receiving end of a wireless outfit.

Lodge used an oscillator consisting of a large polished brass ball between two of lesser size to act as the discharging end of a large coil. These waves possessed great penetrating power, passing through walls and wooden doors and houses as though they were transparent. The fact developed here is, that whereas visible light will only pass through glass in the customary manner, this new type of invisible light wave meets with no difficulty in passing through so-called opaque bodies. A metal screen is effective against them, however, as the waves are absorbed in this case, giving up their energy and decaying.

Sending Wireless Messages.—When the spark coil is set into operation a torrent of sparks will pass between the discharge knobs. The size of these knobs, the gap between them and the dimensions of the coil determine the reaching power of the waves. When a signal is to be sent the sparks are allowed to pass between the knobs by closing a switch. At the receiving end a coherer is affected by the waves propagated; either a long or a short signal is received as in the Morse code, the sounder or tape delivering the ultimate result. If a signal is to be transmitted the other way, the identical process and apparatus is employed. Thus with a good wave-producing coil and a sensitive coherer the fundamental parts are complete.

Antennæ.—To receive the waves, towers or metallic poles are employed called antennæ. The coherer is connected with them, and is thereby made more readily sensitive to electric waves in the vicinity. In transatlantic wireless telegraphy they are indispensable. Ocean liners are peculiarly serviceable in the art of telegraphing without wires, and in consequence, stations have been installed in many of them, thus keeping in communication with the shore of America or England or both while steaming over the ocean.

PROPERTIES OF SHEET STEEL.

The report of the researches carried out during 1904-5 by the holders of the Andrew Carnegie research scholarships has just been issued by the Iron and Steel Institute. The subject of the magnetic and electric properties of various kinds of sheet steel and steel castings is dealt with by Messrs. G. Dillner and A. F. Enstrom, of Stockholm, says the "Electrical Engineer," London. The chief object of the investigation was to study the influence of chemical composition and of manufacturing methods on the materials used in electrical engineering work, more especially in dynamo and transformer construction.

In summing up the authors deal with the influence exercised by various elements. The fact that an increase of the carbon percentage implies a corresponding increase of the coercive force of the hysteresis energy loss has been very distinctly borne out by the figures obtained for the sheet metal. The increase of the coercive force and the Steinmetz hysteresis coefficient have been found to follow a straight line within the range of a carbon percentage of .5 per cent. Thus it is obvious that a small amount of carbon is favorable in sheets used in armature cores and transformers. As regards the cast steel, however, it seems, to the authors that there ought not to be any inconvenience whatever involved in the increase of the carbon percentage, so far as is shown by the present researches. With the very highest percentage met with in the cast steel employed (carbon=about .30 per cent.) the authors consider the values of the maximum induction and of the permeability at the induction normal in field poles perfectly satisfactory, while the hysteresis properties of the pole material are comparatively unimportant. A high percentage of carbon also produces an increase in the electrical resistance, an effect which must be considered advantageous.

An increase of silicon has been found to be accompanied by a quite noticeable increase of the coercive force and of the hysteresis energy loss, whilst the maximum induction does not seem to be influenced to any noteworthy extent. As the hysteresis loss is thus so largely increased by reason of the presence of the silicon —a disadvantage, by far outweighing the corresponding gain as regards electric resistance—the conclusions to be drawn are that any addition of that element in making the steel ought, as a rule, to be avoided in the case of sheet material.

As to the influence of a similar increment of silicon in cast steel, the results have proved to be anything but unsatisfactory, the electric resistance being quite noticeably increased.

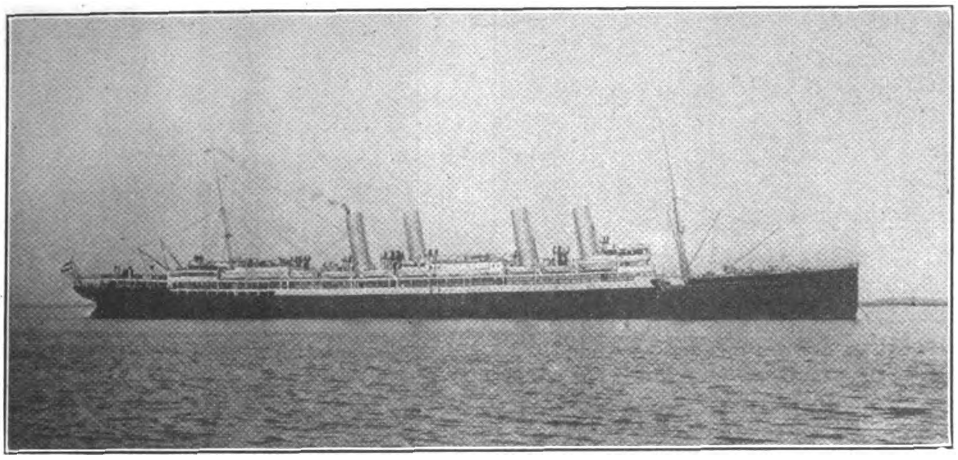
It has been stated that an addition of aluminum quite noticeably reduces the hysteresis loss, whilst it increases the electric resistance, and thus reduces at the same time the eddy-current loss. It has been found, too, that an addition of aluminum will reduce the maximum induction and the permeability for ordinary saturation values. The general conclusion is, therefore, that an addition of aluminum improves sheet material which is to be used for constructing dynamos.

As regards cast steel the matter is different. With such a high percentage of aluminum as is required in order to increase the electric resistance to an effective degree, the magnetic properties will be too much affected, and the authors point out that the usefulness of aluminum in cast steel is, to say the least, questionable. It is of interest, however, to notice the results obtained from the researches on cast-steel rods containing both silicon and aluminum. In this case low hysteresis losses are found, attributable, probably, to the influence of aluminum, whilst the influence of this element on the permeability and maximum induction seems to be neutralized by the addition of silicon. The addition of silicon and aluminum together seems thus to tend towards a general improvement of the magnetic properties.

THE ELECTRICAL PLANT OF THE STEAMER "DEUTSCHLAND."

BY EMILE GUARINI.

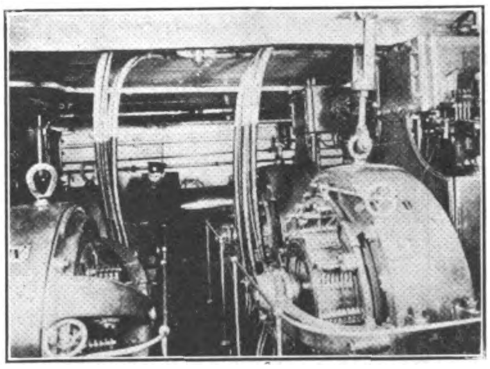
The electrical plant for illumination and transmission of power on board the fast mail steamer "Deutschland," of the Hamburg-American line, the largest and fastest passenger ship of the entire navy of the world, comprise what amounts to a municipal electric supply station of medium size. The entire electro-technical part was designed and constructed by the Allegemeine Electricitats Gesellschaft, Berlin. On account of the extraordinary dimensions of this steamer, namely 208.5 m. length, 20.4 m. width and 13.4 m. depth between upper deck and keel, 2,550 incandescent lamps were required for illumination, while 23 electromotors are used for operating the various supplementary machines. For all parts of the electric plant the necessary spare parts are also on board, and a special staff of men attend to the entire electrical apparatus under the supervision of two electrical engineers.



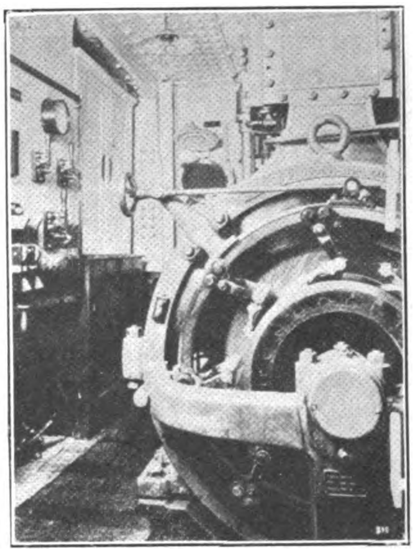
The Deutschland.

More than half of the motors serve for driving fans for the ventilation of the different lower rooms of the vessel. Two of these ventilators, which are erected on the upper deck, provide for fresh air supply in the cabins of the engine drivers and stokers. Four other larger fans serve for ventilating part of the stokehold. The motors, the shafts of which are coupled directly to the shafts of the fans, are suspended from the ceiling of the boiler rooms. Notwithstanding the coal dust, which is of course always present, and the unavoidable accumulation of moisture and dirt, the motors run continuously and quite satisfactorily, without special attention or supervision. Besides various elevators for coal, provisions, postal parcels and the like, a kneading machine in the confectionery department is operated by an electromotor with worm gearing. The starting resistance is situated close to the motor and can be readily operated by the confectioner. In the engine room there are two electrically driven drilling machines used for making small repairs during the voyage.

The lighting plant is very extensive. The distribution of the circuits is such that on an average five incandescent lamps are switched on one circuit and in the cabins up to six contact boxes are provided. Only in the saloons, where electroliers having several lights are used, circuits up to 12 lamps are allowed. Each passenger's cabin contains a lamp with two on-and-off switches, one being provided on the door and the other at the head end of the berth; furthermore, a wall plug for curling tongs heater or for ventilating fans is fitted. The staterooms are more amply provided with electric light, according to the elegance in which they are furnished; the same applies to the sitting rooms of the captain, chief engineer, assistant engineer, first mate and physician. The staterooms are also furnished with electric heating apparatus, stoves being provided in the sitting, sleeping and bath-rooms. Those passenger cabins that face the sea, and consequently have the benefit of daylight, are also connected to the general lighting plant, while those located towards the interior of the ship, and consequently dark at daytime, are connected to the pilot lighting plant. This plant comprises all the lamps which are required for service, and also for the safety of the vessel, passengers and crew, and especially for the illumination of the engine and boiler rooms; also the lamps which are required for harbor duties and for cleaning the saloons and those for the cabins of the crew, all the remaining lamps being connected to the circuit for the general illumination. The lamps in the rooms for steerage passengers are provided with water-tight protecting glasses and guards, like the engine room lights. They have, however, also a cast-iron protecting casing, which is open when the rooms are occupied by steerage passengers, but can be closed when these rooms are employed for stowing cargo. In the gangways between the cabins are provided more artistic fittings with opal glass globes. In the numerous rooms, which are furnished in an elegant style for the use of the first-class passengers, the electroliers are of tasteful construction, while all the electric leads are fixed behind the woodwork of the ceiling and walls. Special reference should be made to the first-class saloon in the middle main deck, the large dome of which gives light to all the three upper decks. The first-class drawing room and first-class smoking saloon on the promenade deck are also provided with the electric light in a manner suitable to their requirements. The promenade deck, which is practically open, is provided with special flat water-tight fittings. Near the cargo openings coal doors, likewise situated on the promenade deck level, are provided water-tight plugs for connecting hand lamps and reflectors which are employed for illuminating the promenade deck during loading and unloading when coaling and also on special occasions. All



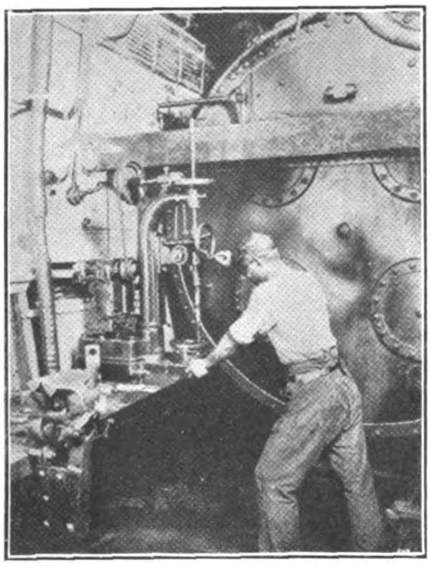
Lower Dynamo Room.



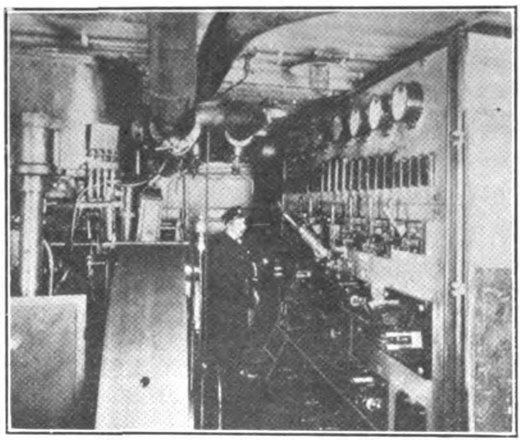
Smaller Dynamo Room.

the signal lights are operated by electric lamps, and especially the two ship's side-lights and the mast headlight. The latter is secured to the mast by means of a rope, the current being supplied through a flexible cable. In order that the captain or officer on duty may have a constant guarantee that these lamps are burning properly, they are directly connected to an electromagnetic controlling apparatus located on the bridge deck. This apparatus has three openings which are closed by white, red, or green panes of glass and show the same color the corresponding signal lamps are burning, whilst that pane of glass is immediately obscured when the circuit of the corresponding signal lantern fails. The stern lantern and also some lamps on the fore and quarter decks are constructed like the engine room lights.

The required current is generated by five steam dynamos, each consisting of a vertical compound steam engine coupled direct to a continuous current dynamo. The speed of these engines is 250 r.p.m. and the pressure of the current 110 volts. Three of these steam engines have cylinders 300 and 500 mm. in diameter with a stroke of 225 mm., while each of the corresponding dynamos gives an output up to 700 amperes. The remaining two smaller engines have cylinders 270 and 450 mm. diameter respectively, the stroke being 200 mm.; each of the corresponding dynamos has an output of 400 amperes. The windings of the dynamos are provided with special insulation; the magnet frame is composed of two parts, so as to readily enable the armature to be replaced in the limited space. The commutators are made of a special width and the current is collected by carbon brushes. The two larger and the two smaller of the steam dynamos are erected below in the vessel in the dynamo room, located behind the main engine rooms, between both propellor shafts. The fifth dynamo is erected in a second smaller dynamo room which is likewise accessible from the main engine room, but situated on the main deck above the water level. The current is conveyed from the four dynamos through iron-wire armored lead and rubber-covered cables to the main switchboard in the same room. The current is conveyed in a similar manner in the upper engine room to the smaller switchboard located therein and from these switchboards to the main circuit. This is composed of three principal parts—the pilot plant, the general lighting plant and the power transmission plant.



otor-Driven Drilling Machines.

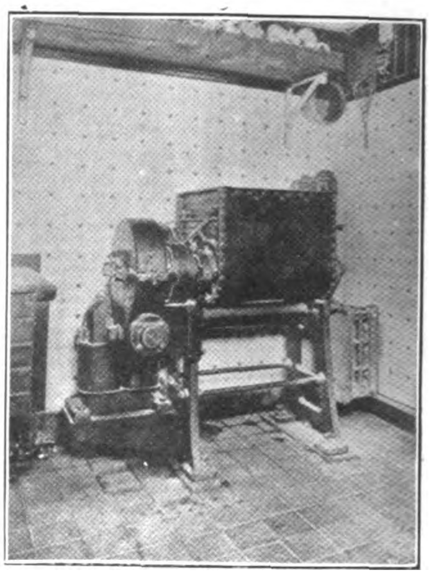


Main Switchboard.

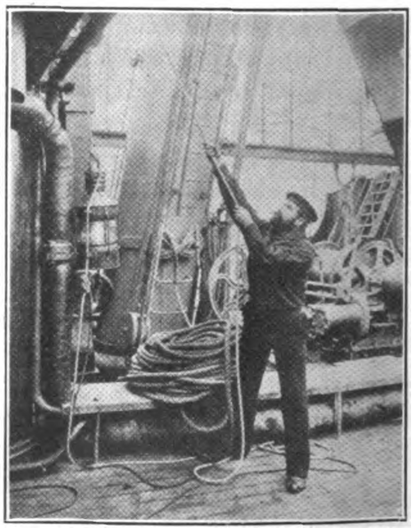
The circuits of the pilot lighting plant are fed from the switchboard in the upper room, while the general lighting and power circuits are fed from the main switchboard in the lower room.

Since the dynamos are not for working in parallel, the arrangement is such that by means of a four-part two-way switch each of the lower dynamos can be connected up to any circuit of the general lighting or to the bus bar of the power plant. By a similar switch, it is, however, also impossible to connect up each dynamo on to the switchboard in the upper engine room, that is, to the pilot lighting plant, for which purpose a trunk main is provided between the upper and lower switchboards. This conductor is in direct connection with a two-way switch by means of which any one of the lower dynamos or the upper dynamos can deliver its current to the upper switchboard. Dead-beat instruments made by the A. E. G. are used as measuring instruments, as they work accurately in any position notwithstanding the rolling movements of the vessel.

Connecting Hand Lamps and Reflectors.



Motor-Driven Kneading Machine.



Masthead Light Supplied Through a Flexible Cable.

In the engine and boiler rooms, the conductors are connected as a ring main, to which are attached water-tight boxes for the single lamp circuits. Each box contains eight branch circuits for one lamp, with the necessary safety fuses and cut-outs. Like the branch-circuit boxes in the engine and boiler-rooms, there are provided in the remaining parts of the vessel distribution boxes from which the conductors lead to the lamps. The boxes are distributed in such a manner that those spaces, which by their position or their use constitute a group, have always one common distributing box. Each box consists of a marble slab upon which the necessary switches and safety fuses are provided and embodies both the pilot lighting and the general lighting plant, for which the back part is provided with separate bars having a separate current supply. The connection of all the conducting wires takes place at the back of the distribution-box, from whence the wires are led into the adjoining wood casings. The single switches are provided with small plates, on which the individual circuits are indicated. All circuits are protected by 10 ampere plug fuses.

A NEW AMERICAN ELECTRIC ROAD ELEVATOR.

BY FRANK C. PERKINS.

The accompanying drawing, Fig. 1, and illustrations, Figs. 2. and 3, show a most interesting electric road elevator or rolling road for horses and wagons, as installed and operated on Factory Hill, in Cleveland, O. This electric road elevator is very similar to the incline elevator used in stores for carrying shoppers from the lower to the upper floors. The horses and wagons on moving upon the incline are carried up the 20 per cent. grade, and are deposited at the top of the hill without effort on the part of the men or horses. The main portion of the city of Cleveland is located on a level nearly 70 feet higher than that section occupied by the coal yards, lumber yards and manufacturing plants which are situated along the Cuyahoga River on the Flats. On account of the great amount of traffic and heavy teaming required from the Flats to the upper level, a long distance has to be traversed through various streets by the wagons and carts, and the loads hauled must be comparatively light on account of the heavy grades. By the installation of this electric road elevator by the Cleveland Rolling Road Company, which was designed by Col. I. D. Smead of Cincinnati, O., the horses, wagons and other vehicles are able to take the most direct line from the Flats, the rise of 65 feet in about 400 feet being made by means of this mechanism in a few minutes, while heretofore from half an hour to an hour was required to mount the hill by the roundabout way. This electric rolling roadway runs on several thousand small wheels; the roadway revolving around an immense sheave at the upper end, the returning belt running underneath on idlers provided for the purpose to a similar wheel or sheave at the lower end of the incline.

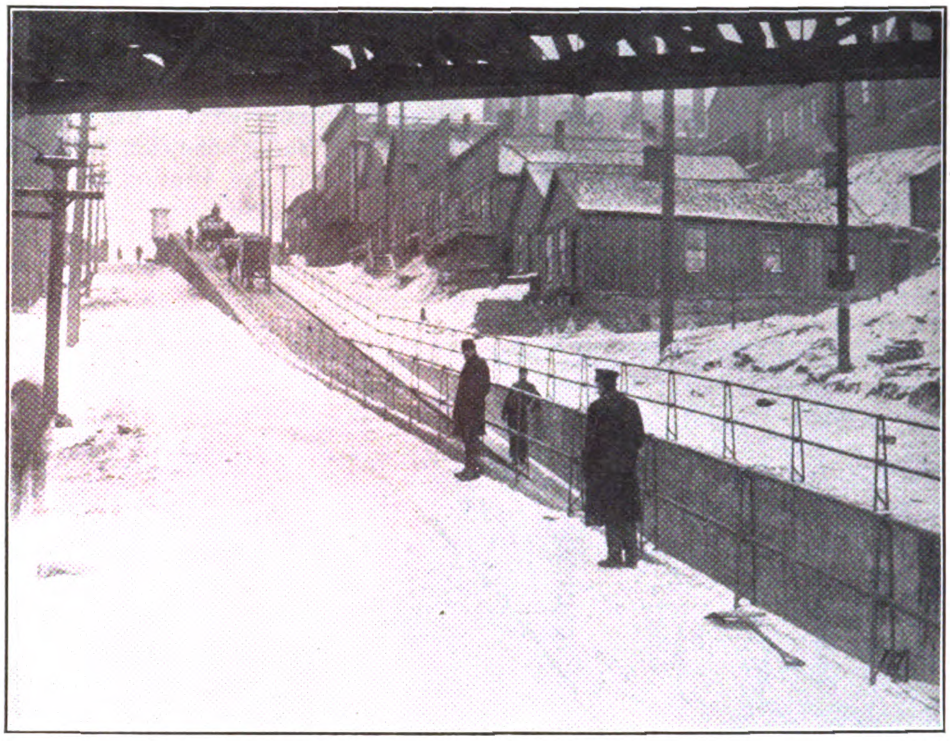


Fig. 2.—On the Hill by the Electric Road Elevator.

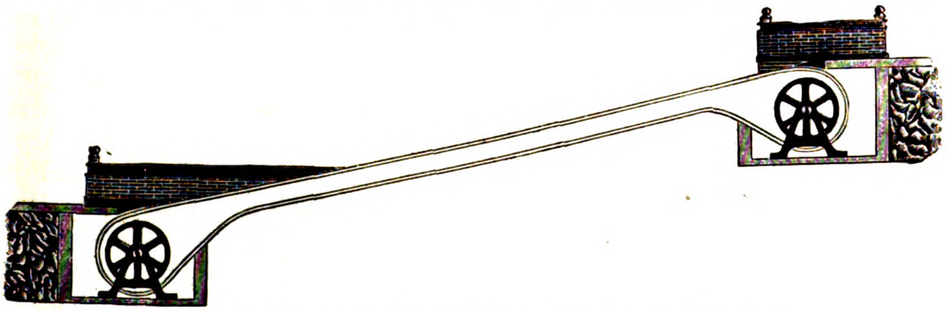


Fig. 1.—A New American Electric Road Elevator.

The capacity of the road is about 600 vehicles per day, and the horses while somewhat surprised pay little attention, seldom being alarmed, even for the first time. The speed of the electric rolling road is about three miles per hour and a number of wagons can be handled at the same time, as the roadway can be started and stopped when desired. The operating mechanism consists of four electric motors placed at intervals along the incline, all of which are operated by a single controller, the endless belt being started and stopped any time. The vehicles are driven upon the rolling roadway, one at a time, as many as six wagons having been carried up the incline at the same time with loads as high as nine tons, including the horses and wagons, while the time required for the trip is about three minutes, including the stops necessary for the other vehicles to get off and on the rolling road. It is stated that the cost of transportation of teams up this incline is about 10 cents per trip, thus saving a number of times this amount in case the vehicle with a much lighter load was required to take the roundabout way, with the additional wear and tear on the horses and vehicles and the increased time required.

PROGRESS IN THE ELECTRO-CHEMICAL AND ELECTRO-METALLURGICAL INDUSTRIES IN EUROPE IN 1904.

BY JOHN B. C. KERSHAW,
London.

Aluminum.—The production of aluminum in Europe is at present stationary, and is estimated by the writer to be about 4,500 tons per annum in the six factories engaged in the industry. During 1904, however, the British Aluminum Company extended its reducing plant at Foyers in Scotland, and is now generating machinery equivalent to 6,300 hp. installed. The manufacture of calcium carbide under the Willson patents at this works has been suspended, and the whole of the power is to be devoted during 1905 to the manufacture of aluminum.

Since the output of the six European works is at present only about one-half the capacity of the generating plant installed, a considerable increase in production may be expected shortly. A new company for promoting the manufacture of aluminum in Italy was floated in Rome last year, and a works is to be erected for this purpose in the valley of Pescara. Native bauxite will be employed as raw material.

As regards utilization there is nothing new to report during 1904, beyond the formation of an English company to exploit the Goldschmidt patents in the United Kingdom. These patents relate to the use of aluminum and oxide of iron, in the form of a powder named "thermit," for obtaining very high temperatures for welding and other metallurgical purposes. The new company has been called "Thermit Limited," and has a capital of $240,000. The fused mass of alumina, produced when "thermit" is fired, is also being employed for trade purposes, under the name of "Corubin."

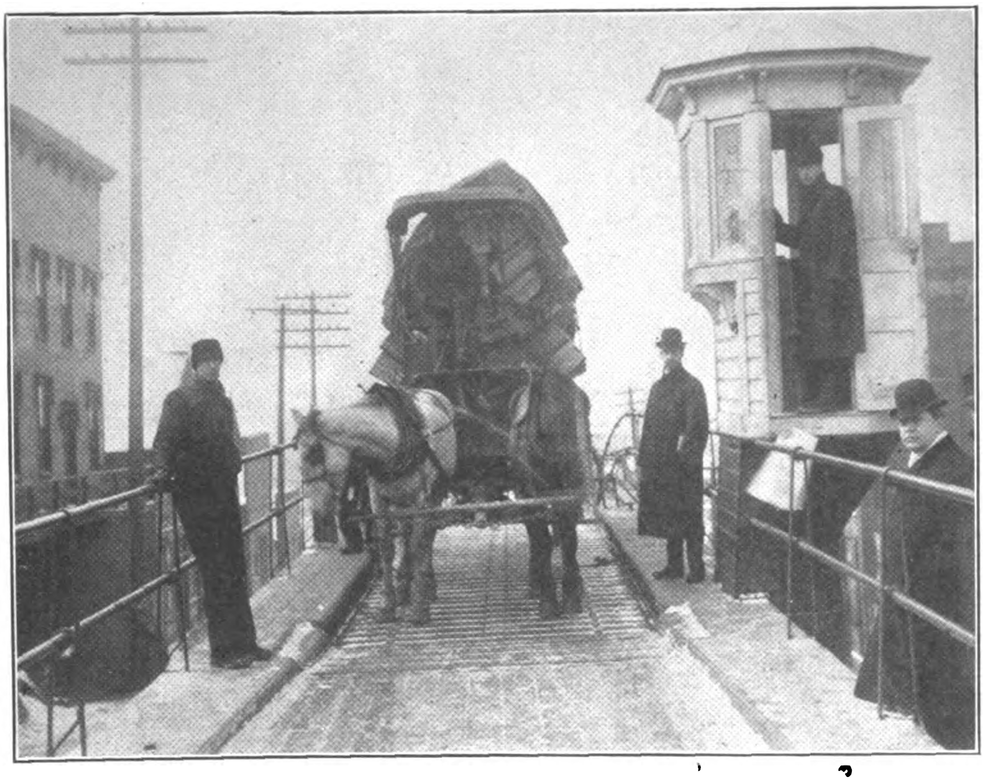


Fig. 3.—Scene on the Electric Road Elevator.

The use of aluminum for overhead transmission lines in place of copper does not make much headway in Europe, as the distrust of engineers in the durability of the metal when exposed to damp climates, has not been overcome.

Two Sheffield artisans patented, during 1904, a method and process for obtaining adherent deposits of silver upon aluminum, which may have some important effect upon the electro-plating industry. At present, copper or white metal, is usually employed as the base metal of all silver-plated goods, and this invention will substitute for these a lighter and cheaper metal. It is, however, yet too early to pronounce a definite opinion upon the success of this innovation.

Alkalies and Bleach.—The electrolytic alkali and bleach industry has not been in a very flourishing condition during 1904 The effects of the rupture between the La Blanc and electrolytic makers which marked the year 1902, and the consequent fall in the price of bleach, have not been entirely remedied by the modified form of agreement which was adopted in 1904. The price of bleach has not reached its former level of $30 per ton, and at present is only about $21.87 f. o. b. Liverpool. Consequently most of the electrolytic alkali makers in Europe, find the manufacture of this chemical unremunerative, and are seeking other outlets for the chlorine produced in their electrolytic alkali cells.

In this country the Castner-Kellner Company is making zinc chlorine by the Swinburne-Ashcroft process; in France the Societe la Volta, at Moutiers, is producing carbon tetra-chloride; and in Italy the Electrolytic Alkali Company, with works at Piano, is manufacturing carbon tetra-chloride, and pure hydrochloric acid. Attention is also being given to the industrial recovery of the hydrogen escaping from the cathode compartments of the cells (1 ton of hydrogen is produced for every 35 tons of chlorine); and in Germany and France this gas is being collected, dried, compressed and sold in steel cylinders for various purposes.

As regards dividends, the Electrolytic Alkali Company, which works the Hargreaves-Bird process at Middlewich, has passed its dividend upon the ordinary and preference shares during 1904, while the Castner-Kellner Company, with works at Weston Point, has been obliged to reduce its distribution from 6 per cent. to 4 per cent.

Calcium Carbide.—The Willson patents for carbide production, purchased in 1895 by the Acetylene Illuminating Company, have been declared invalid in the United Kingdom during 1904, as the result of litigation carried to the final Court of Appeal in the House of Lords. The manufacture of carbide under these patents at Foyers in Scotland has ceased. Only two small works are now producing carbide in the United Kingdom—at Ingleton, Lancashire, and at Askeaton, in Ireland, respectively, and the bulk of the carbide used is imported from Norway and Sweden. The total number of carbide works in Europe, now operating, is estimated by the writer to be about 45, and the output about 50,000 tons per annum.

As regards utilization the use of acetylene gas for illuminating purposes in country districts, is undoubtedly extending in Europe, and it has recently been stated on good authority that there are 150 central installations of this type now in existence. In the United Kingdom 16 towns and villages are provided with acetylene gas from a central generating station, and the average price charged for the new illuminant is stated to be $13.26 per 1,000 cubic feet. An improved form of acetylene lamp is now being tried upon the London omnibuses with some success, and the lamp, so far, promises to be more satisfactory than that tried two years ago.

The consumption of carbide in Italy and France in 1902 was stated to be about 13,000 tons in each case, and the consumption in Germany in 1904 has been estimated to amount to 20,000 tons.

Chlorates.—Little change has occurred during 1904 in the electrolytic chlorate industry. The number of factories in operation in Europe remains stationary at six, and the aggregate power available for the manufacture in these six factories is about 25,000 hp. No very reliable figures can be obtained for the output of chlorates by these six factories and estimates based on the total power are misleading as some of the factories manufacture other products. Chlorates now command a very low price on the market and the tendency is for these works to devote an increasing proportion of their power to the manufacture of persulphates, perchlorates and similar salts.

Copper.—The electrolytic copper refining industry is practically stationary in Europe, though still expanding in the United States.

This position is due to the fact that most of the raw copper suitable for the electrolytic refining process is mined in America, and that this raw copper is now refined on the other side of the Atlantic. The European refineries, according to Ulke, No. 23, provide only 14 per cent. of the total output of refined copper. The latest available figures are for 1903, and show an output of 324,000 tons of refined copper, to which total Europe contributes only 45,360 tons. These figures indicate that the European refineries, though numerous, are small in size, and that difficulty is met with in keeping them provided with raw copper for the vats.

The companies which operate the Elmore process for manufacturing tubes by electrolyte deposition, at Hunslet near Leeds, and at Schladern in Germany, have not been operating very successfully in recent years and the former company has been completely reorganized in finance and management during 1903-1904. The electro-metallurgical processes for treating poor copper ores to a preliminary smelting in the electric furnace, in order to obtain a concentrated metal, are still receiving trial in France and in Chili.

Ferro-alloys.—The manufacture of special alloys of iron with chromium, manganese, tungsten and silicon in the electric furnace has become an important branch of electro-metallurgical industry, and the number of works which are engaged in manufacturing these compounds in France, Switzerland and Germany, is a large and increasing one.

Ferro-chrome, which is employed in the manufacture of tool steel and armor plate, on account of its hardening properties, is produced at Froges and La Praz in France by the Heroult furnaces, at Albertville by the Girod crucible furnace, and at Essen in Germany by the Goldschmidt aluminum reduction process. A plant for operating the Girod crucible furnace is also being erected at Courtepin in Switzerland, and here numerous special alloys of iron and steel are to be made. Ferro-manganese is stated to be a product of a works situated at Orlu in the French Pyrenees. Ferro-silicon is manufactured at a great number of works and the output has grown so large that a central bureau has been called into existence for regulation of the production and price.

The carbide works at Landeck and Matrei in Switzerland have recently taken up the manufacture of the last-named alloy.

Hypochlorites.—The low price at which bleaching powder is now being sold in Europe is retarding the development of the electrolytic hypochlorite industry—and thus the success of electrolytic methods in one direction (namely the alkali and bleach industry) is retarding their progress in another.

Kellner has recently patented in Europe a method of producing and using a hypochlorite of lime solution for breaking up wood fiber, which is electrolytic in character, and is similar to the processes that have been used in certain wood pulp mills in the United States for some years past. Two companies are exploiting hypochlorite cells in the United Kingdom, namely, the Electrical Bleaching Company and Oxychlorides Limited. The first-named company controls the Vogelsang cell and patents, the second, the Atkins cell and patents. Neither company has yet obtained any very striking results.

In Germany, the Schuckert and Haas & Oettel cells are most frequently heard of in connection with electrolytic bleaching plants.

Iron and Steel.—The use of the electric furnace in the iron and steel industries has been forced into much prominence during 1904 by the visit of a Canadian Government Commission of experts to Europe to inspect and report upon the prospects of the various furnaces and processes in operation upon an industrial scale in France, Sweden and Italy. The reports of the experts attached to this commission were published towards the end of 1904, and have received much attention in the technical press. The reports are favorable to the new methods, especially as regards the manufacture of high-class steels, and therefore there is likely to be a rapid growth of this new branch of electro-metallurgical industry in all countries in the next decade. Although Siemens experimented with an electrically-heated laboratory furnace for melting steel in 1879, the more serious experiments with the electric furnace in the iron and steel industry dated from 1899, when Stassano at Rome and Heroult at La Praz, commenced their trials with different types of furnaces.

The former attempted to make steel from the raw ore in one operation, the ore, coke and lime being pulverized and formed into briquettes with some suitable binding material before submitting it to the action of the electric arc. Although much money has been expended upon these experiments, the success of the Stassano process and furnace is still in doubt and it remains to be seen whether a process of this character can be made to pay at present except under very unusual conditions.

The Heroult process starts, not with ore, but with scrap iron and steel, and from these materials high-class steel of any desired chemical constitution is produced. The method of manufacture is based upon first washing out all the impurities by means of suitable slags, and then adding alloys containing the required constituents in sufficient amount to produce the finished steel desired.

The Heroult process and furnace has been developed at La Praz in France and at Kortfors in Sweden, and over 4,000 tons of steel have been produced at these two places. Arrangements have now been made for introducing it into Germany and the United States.

The Keller furnace is another for producing steel from scrap, which has been working in France for the last three years, at Livet and at Kerrousse, near Morbihan.

The Keller steel refining furnace in its principle details resembles the Heroult furnace, but Keller has also designed one for making pig-iron from the ore, which has some features of peculiar interest. In this furnace, two vertical chambers which contain the electrodes and charges of ore, coke and fluxes, are connected by a channel at their lower ends—and when this channel fills with molten iron the latter begins to act as electrical conductor, and changes the action of the furnace from the arc to the resistance principle of heating. Cast-iron of various grades has been made in this type of furnace with success, but the Canadian commissioners indicate in their report that under normal conditions it cannot compete with the modern blast-furnace.

The third furnace seen in operation by the commissioners was at Gysinge in Sweden and is known as the Kjellin furnace. This operates on a totally different principle to the other two, the heating of the charge being due to induction currents. Either cast-iron or high-class steels can be made in this furnace, and the results obtained when working with scrap-iron and steel as raw materials of the charge, and when producing from this high-class steels, were fully equal to those obtained at Livet and La Praz with the Keller and Heroult process. The cost of electrical energy per ton (2,000 lbs.) of steel produced in the furnaces varies from $1 to $1.52 with the EHP. year at $10. This, it must be observed, is only one-half the rate charged at Niagara, so that the new electric steel processes will require a very cheap power supply if the above figures of cost are to be realized.

Nitric Acid and Cyanides.—Much attention has been given in Europe during 1904 to the problem of obtaining nitric acid and cyanides from the nitrogen of the air and some progress has undoubtedly been made in the solution of this problem.

Birkland and Eyde, two Swedish chemists, have been experimenting with a spark discharge method, similar in many respects to that employed by the Atmospheric Products Company (Bradley and Loejoy's patent) at Niagara Falls, but the two Swedish inventors use a moving magnetic field, in place of a mechanical device, to break the arcs when formed. The yield of HNO_3 by this method is stated to be 900 kgs. per kilowatt year, and the air after submission to the action of the spark discharge is said to contain ⅔ per cent. of NO, which is finally oxidized to N_2O_5.

A large number of laboratory investigations relating to the same subject have also been carried out during 1904 by Brandt, Muthman and Hofer, von Lepel, and Auer.

As regards cyanides, the Siemens & Halske and Franke process, for production of calcium cyanamide, by heating lime and charcoal to 2,000 degs. C. in an electric furnace and then passing air over the heated mass, is in operation in Berlin, and the product is being sold in Germany under the name of "kalkstickstoff" as a manure. Sodium and potassium cyanide can be obtained from this compound by double decomposition. A works for carrying on this manufacture on a large scale is to be erected in Italy by a company having its headquarters in Milan. The German patent for this process is No. 16,298 of 1902.

Nickel.—There is nothing new to report concerning the use of electrolytic methods in refining this metal.

Tin.—The electrolytic methods for stripping tin scrap are making progress, and in time the writer believes that every large city in Europe and America will be provided with a factory for carrying on this process.

The Bergse process, in use in Copenhagen, was described in various magazines during 1904. Stannic chloride is used in this process as solvent in place of sodium hydrate, and the results obtained are stated to be good. Chemical methods of detinning scrap by aid of electrolytic chlorine are also receiving attention. A large detinning works is now in operation in London.

Zinc.—The Swinburne-Ashcroft zinc extraction process is being employed at the Castner-Kellner Alkali Works at Weston Point, chlorine gas from the electrolytic cells being used to decompose the mixed sulphide ores. The plant at present in use can deal with 40 tons of ore per week and extensions are possible.

The Laval furnace and process is undergoing industrial development in Germany and Sweden. This is an electro-thermal process, arc heating being employed, the zinc being driven off as a vapor and finally condensed. By the exclusion of air from the furnace the formation of oxides is avoided.

THE PRODUCTION OF ELECTRICAL POWER.*

Amongst the accessory appliances in use in a power station secondary batteries or accumulators claim some attention because of their importance.

Accumulators are made of lead grids, filled in with oxides of lead. These are immersed in dilute sulphuric acid. When a current from a dynamo or a battery is passed through the accumulator cell some of the water may be considered, for all practical purposes, to be electrolyzed or split up into its components, hydrogen and oxygen. The oxygen appears at the anode, or the plate of the cell at which the current enters, the hydrogen at the cathode or the plate by which the current leaves cell. Now the hydrogen liberated at the cathode attacks the lead oxide and takes some of its oxygen from it to form water, and leaves the equivalent amount of lead on the cathode. The longer the current is continued the greater is the amount of oxide reduced to lead. This action, however, does not go on until all the oxide on the cathode is reduced, as the surface is acted on first, and the lead forms an outer coating which to some extent protects the inner portions. The oxygen at the anode acts on any oxide on this plate, converting it into lead peroxide, a dark brown substance containing more oxygen than the other oxides of lead.

If the connections at the terminals of the cell are now reversed so that the current flows through the cell in the opposite direction, hydrogen is produced at the plate which previously was the anode, but which has now become the cathode. The hydrogen attacks the peroxide of lead, taking its oxygen and reducing it to metallic lead. This lead, thus produced, is in a very porous or spongy state. The oxygen liberated at the plate which was formerly the cathode, but now the anode, attacks the lead formed previously, and it does this the more readily owing to its spongy state. Lead peroxide is formed as before described. This process may be repeated and each time the action goes further, until the cells are in a condition such that the action can get no further. The plates are then said to be fully formed. In the acid we then have two different plates, one of which may be regarded as lead, and the other as lead peroxide, and these plates are necessarily at different potentials because of the different action of the acid on them. On connecting the terminals to a voltmeter, we find that there is a difference of somewhat over two volts between them. Hence if we connect them by a wire they will give rise to a current just in the same way as a primary battery. The current will flow for a considerable time, provided too great a current is not taken from the cell. The voltage of the cell keeps up remarkably well, but of necessity there is a decrease as the action goes on, for the lead is gradually oxidized and the lead peroxide reduced.

The current produced by the cell leaves by the brown lead peroxide plate. This is, therefore, termed the positive terminal, or pole, of the cell, and is usually painted red. When the voltage has fallen to 1.9 or thereabouts the current should be stopped and the cell recharged by sending in a current at the positive terminal, thus again producing lead peroxide at the positive plate. In this way the cell can be recharged and used over and over again, and, in a certain sense, we can speak of these secondary cells as accumulators, for we charge them by means of an electric current, and we can take a current from them when we wish. The explanation just given of the chemical action taking place in the cell must not, however, be taken as being complete. As a matter of fact the action is very complicated, persulphuric acid, persulphates of lead, and other substances being formed. The above, however, gives a general idea of what is taking place. The cells used in the power-station each contain a number of plates, but these are connected together in such a way that they really form two large plates for each cell. These cells possess many advantages in addition to their capability of being recharged: they give a comparatively constant voltage, and have a very low resistance, so that very little energy is wasted in the cells themselves. Great care must, however, be taken in using them, otherwise they are soon spoiled.

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* Abstract of article in "The Tramway and Railway World," London.

In practical use in the power-station we may explain their usefulness by saying that they are used to equalize the loads on the dynamos. Both dynamos and steam engines work most efficiently when the load on them is constant. Now, on a tramway system sometimes the current required is much smaller than at others. At such times the energy given by the dynamo is utilized for charging the accumulators. The dynamo and battery are connected up so that this is done automatically. At other times, say when a considerable number of cars happen to start at the same time, a sudden load is thrown on the dynamo, but if this is connected up with the battery the latter takes part of the load. In this way the battery acts as a kind of a buffer to the dynamo, and consequently to the engine also, for if the load on the dynamo is kept fairly steady the power required from the engine and boilers remains steady also.

In some cases a battery of accumulators is used for working a tramway system during some parts of the day. This method has been adopted in some combined electric lighting and traction power stations where the dynamos are used during the daytime to work the cars and charge the batteries, while at night the dynamos are used for lighting and the battery for working the tramways.

In many power-stations are now to be found small machines, known as boosters. A booster is practically a motor and dynamo combined. It is used for modifying the drop in voltage on the feeders of a tramway system, or on the track which is used as the return conductor. When the booster is working one of its terminals is at a higher potential than the other, and this potential difference may be made to have any value required according to the winding of the machine and the speed at which the armature rotates. If it is required to raise or lower the difference in potential at two points on the circuit, this can be done by connecting the two points to the two terminals of the booster.

Boosters are also frequently used for charging the accumulators instead of connecting them direct to the dynamo. When used for this purpose they are called milking boosters. This name seems to have been given to them because when the battery is almost fully charged the gases liberated escape through the liquid, making the liquid appear white and semi-transparent or milky.

ELECTRICITY AND FIRE INSURANCE.*

BY A. H. MAYES.

The unfair and inconsistent attitude adopted by many fire insurance companies with regard to premises wherein electric power for lighting and motive purposes is used, is of such wide importance that a little plain speaking will be entirely justified. In the first place, it appears that the powers that guide the helm of the insurance companies have by some mental process, which it is beyond the power of a practical and impartial person to understand, arrived at the conclusion that a supply of electricity on a premises is a source of considerable fire risk, greater, in fact, than had gas or some other agent been employed. Now, looking at the matter honestly and with a perfectly unbiased mind, one is compelled to say at once that such a contention is absolutely unjustified, opposed to common sense, and totally unsupported by the result of experience.

Even allowing that every fire attributed to electrical causes is rightly classified, it cannot be denied that electricity still stands forth as by far a safer agent than gas. It is quite certain that a little more attention in detail in carrying out installations would still further reduce the possibility of fires from electrical causes, and the writer proposes to say a few words upon this from a practical standpoint. How often one sees the cause of fire vaguely attributed to "the fusing of an electric wire." Now, either the fire was not caused in this manner at all or else the wire in question must have been installed under conditions sufficiently extraordinary to take one's breath away. The smallest conductor ever used, or which is supposed to be used for installation purposes, is No. 18 S.W.G., and as the fusing current of No. 18 S.W.G. copper wire is 108 amperes, one is led to ask what sort of branch fuse was in circuit with that unfortunate wire. The alternative conclusion is that there was no fuse at all, and, furthur than that, one is confronted by the appalling question of how such an enormous current could have found its path, even then, through the wire in question. If due to earthing of the wire, the earth must, indeed, have been of an efficient character, and if due to a "short-circuit" the point of contact must have had a strangely low ohmic resistance. Even then we are not out of our troubles, for we have yet to explain how the service company's fuses managed to stand against this great extra demand upon their energies. It will, of course, be evident that the danger point would be reached with a current less than that required to absolutely fuse the wire, but after making all allowances the point requires a large amount of explanation.

Another and more probable source of danger is in installing incandescent lamps in such a manner that the heated bulbs can come into contact with articles of an inflammable character. It is a common practice when installing lamps for lighting a draper's window to attach the lamp to a considerable length of duplex flexible conductor, in order that the light may be hung in any desired position, and thus it is that one frequently sees goods of a highly inflammable character in actual contact with the bulbs. Such a practice as this should be absolutely prohibited, and a rule should be strictly inforced that all lamps used under such conditions be inclosed in a wire net guard or other effective safeguard. The overheating of resistances used in connection with arc lamps is undoubtedly a source of danger, but at the same time one which might be rendered practically nil by proper precautions in the matter of carrying capacity and fixing.

Coming to the question of electricity as used for power work, we are at once confronted by an element of danger in the form of resistances as used for starting and speed-regulating purposes. Here again, however, proper precautions would reduce the fire risk to practically nil, but, unfortunately, great carelessness is often displayed in the method of fixing and protecting these pieces of apparatus. A short time since the writer was inspecting a large motor installation in London, and found gross carelessness displayed in the above matter. A 25 hp. starting resistance of the wire coil type had been arranged to stand upon the cement floor in the basement, and as the sheet-iron case containing the coils was open at the bottom, a quantity of waste paper and rubbish had gradually worked its way underneath, and actually found its resting place amongst the coils. The above apparatus should certainly have been fixed about a foot from the ground, and have been provided with a perforated iron bottom.

In several other instances it was found that starting resistances were quite unequal to the demands made upon them, having insufficient carrying capacity, and often attaining a red heat in operation. More care was, therefore, essential in selecting a starting resistance suitable for the particular work to be performed. It may be added that the switch and resistance should always be inclosed in an outer case of strong sheet steel which is an adjunct of a very necessary character on account of the fact that a considerable amount of sparking takes place upon the switch contacts, and particles of molten metal are at times thrown off. Main switches should most certainly be inclosed in cast-iron cases, as they are frequently liable to rough handling, and it often happens that an arc is set up owing to defective action.

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*From the "Electrical Engineer," London.

Another important adjunct to power installations is the fuse, and unless a proper type be employed they are undoubtedly a source of fire risk. Whether the open or inclosed type of fuse be selected, there are two points of the greatest importance to be observed—that is, that the terminals shall be an ample distance apart and the device shall be inclosed in a cast-iron case.

If proper attention were paid to the above simple points the fire risk would be still further reduced, and would bring still nearer the day when fire insurance companies will be compelled to admit that electricity is by far the safest agent to employ for both lighting and power.

Motors May Be Cheapened by the Expiring Tesla Patents.

(From the Washington Star.)

There is a diversity of opinion as to the probable effect the announcement of the expiration of the famous Nikola Tesla patents, covering the alternating current dynamo, will have upon the electrical world.

Among the experts at the Patent Office and among conservative patent attorneys generally it is not anticipated that a stir will be created that will equal the one caused by the dying out of the Bell telephone patent. On the other hand, reports are current that many of the large factories of the United States, in anticipation of the expiration of the patents, have equipped their factories with machinery for manufacturing electric motors on a large scale.

The Tesla patents have been known for years as the "three fundamental patents." For years they have been in possession of what is called the "Patent Pool Trust," and Tesla has been drawing royalties from them. It is said that much of the money the picturesque inventor has received from this source has been applied to his experiments in wireless telegraphy. His mysterious tower at Wardencliffe, L. I., is said to have been built in part by money subscribed by J. Pierpont Morgan and in part out of the royalties received from the motor patents.

George D. Seely, the veteran electrical examiner at the Patent Office, looks for no great stir on account of the expiration of the patents. "There may be some little excitement," he said, "but it will not be an earthquake by any means. It will have the effect of lowering the market price of electric motors some, and probably some manufacturers not now manufacturing electric motors will put them on the market."

The field thrown open by the dying out of the patents is not so large as would appear at a first glance. While the three fundamental principles are absolutely necessary to the construction of an electric rotary motor, the improvements which have been made from time to time enter largely into making the motor of the great commercial value that it is to-day, and the patents on the improvements still stand good.

High-Speed Traction.

At the last meeting of the New York Electrical Society Mr. Charles A. Mudge, chief engineer of the railway department of the Allgemeine Elektricitats Gesellschaft, Berlin, lectured on "High-Speed Electric Traction." As Mr. Mudge took part in the high-speed electric tests on the Berlin-Zossen road, his description of the trials proved very interesting. In dealing with high-speed work the lecturer enumerated the following points, which, he claimed, had to be considered:

(1) Keep the car body as near the rails as possible; (2) arrange all heavy pieces of apparatus so that their centers of gravity lie in the center of the car, or in symmetrical relation therewith, and as near the earth as possible; (3) all apparatus mounted above the car floor should be as light as design will permit; (4) make the overhead trolley contact above, in preference to the side of the car; (5) support the motors flexibly on the axles of the trucks; (6) give the front end of the car a wedge shape; (7) support the car body on the truck frame at some distance from the center bolt, and allow it a flexibility in a line at right angles to the track, independent of the truck; (8) make the total wheel base of the truck of ample dimensions, and not less than 20 per cent. of the length of the car; (9) build the road as straight as possible and where more than one track is used make them farther apart than present practice; (10) on curves make the approaches of the elevated side of the track longer than present practice.

New York City's Central Station.

New York City has acquired the block bounded by East 90th street, Avenue A, East 91st and the East River as a site for the proposed central station for the supply of electricity to light the streets and public buildings in Manhattan and the Bronx.

The sale was consummated last week, the city paying $350,000 for the property, which includes 14 lots under water in addition to the block of land. A plot in Long Island City on Vernon avenue has also been obtained for the erection of a lighting plant to supply the Boroughs of Brooklyn and Queens.

Plans of the proposed building to be erected show a structure similar to the big power-house of the Metropolitan Street Railroad Company at Broadway and Houston street. The machinery to be installed will be the latest up-to-date make.

Points for Electrical Contractors.

Electric lighting works are wanted by the city of Nachod, Bohemia—also by Marburg, Germany, by Johannesburg, South Africa, by the municipality of Druten, Italy, and by the town of Beaconsfield, Cape Colony, South Africa. The electric light plants in Leipsic, Heidelberg and Emden, Germany, and Port Elizabeth, Cape Colony, are also to be enlarged.

Electric central power stations are to be constructed at Reichelsheim, Germany; Wallensch, Germany, and Sentino, Italy.

Electric cranes and other harbor improvements, to cost $930,000, are to be installed at Cape Town, South Africa.

Electric tramway lines are to be constructed at Nankin, China; Paris, France (to cost $3,897,000); Rome to Civita Castellana, Italy, by the Westlandsche Stoomtramway Maatschappi of Amsterdam: Goerz, Austria, Johannesburg, South Africa (consulting engineers, Mordey & Dawbarn, 82 Victoria street, London); Celle, Prussia, and by the Societe Generale des Tramways de Madrid, Spain, and several in Bohemia.

Chicago's Municipal Railway.

Contractors who desire to bid on the construction of the proposed municipal street railway system in Chicago can begin at once to prepare their proposals. Bion J. Arnold, the traction engineer, has filed the plans and specifications for the system with Commissioner of Public Works Patterson in that city. The plans provide for the construction of a trifle over nine miles of track, four miles of underground and five miles of overhead trolley, and all the power plants, cars, transmission lines, repair shops, telephone system and other appurtenances to a complete working system.

Proposals Invited.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until June 20 for furnishing Eastern navy yards with the following electrical supplies: Schedule 288, incandescent lamps, carbons, globes, switchboard extension. Blank proposals and specifications can be obtained upon application to the Bureau in Washington or to the Navy Pay Office in New York.

Sealed proposals are being invited until June 15 for the construction of an electric lighting system and current required at Fort Mansfield, R. I. Information will be furnished intending bidders on application to the Constructing Quartermaster, New London, Conn.

A Work of Instruction and Reference.

The Electrician's Handy Book, by T. O'Conor Sloane, A. M., E.M., Ph.D., is one of the finest pieces of electrical literature this season has produced. It is possible to go even furthur than this in words of praise without in the least encroaching upon the field of verity.

The contents of this volume are completely up-to-date and betray not only a painstaking care in preparation, but a breadth of view that gathers within its compass the latest and best in the theory and applications of electricity. Better than all this it is readable. Specialists in all departments of electrical engineering will find within its covers a fund of useful and well-presented information. It is well worthy of occupying a prominent place among the best books of the hour. Dr. Sloane has accomplished a great deal in this, his masterly resume of electricity.

This flexible backed book is published by the Norman W. Henley Publishing Company, price $3.50. The number of pages included between its covers are 761, and 556 illustrations and diagrams are employed to elucidate this most modern work of instruction and reference.

Latest Municipal Ownership Query.

When the city government of Chicago owns the street railways, will the cars have to wait for the Alderman's wife to finish doing her hair and get on her gloves?—"Baltimore Sun."

Reliance Instruments.

The latest improved Magnetic Vane Volt and Ampere Meters, recently brought out by the Reliance Instrument Company, 60–68 West Van Buren street, Chicago, are claimed to be very neat-appearing, accurate and reliable. These instruments have no permanent magnets and can be used on either A. C. or D. C. circuits. They are not gravity controlled. The pointer is held in position by two springs which have an exceedingly fine temper; the moving parts are very light and the coils are so arranged as to take the least possible current; the losses through winding as well as friction are reduced to the lowest point, and in this feature the Reliance Company claims its instruments are very superior to all other magnetic vane instruments.

RELIANCE
AMPERES
MADE BY
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The amount of energy consumed in Reliance voltmeters for a full deflection of the scale is considerably less than the average instruments of this type, which means a great saving in the operating of a power plant or automobile charging boards, as a voltmeter is constantly in circuit and the energy consumed to indicate the voltage is a total loss to the plant. The construction of Reliance instruments is of the most substantial kind. The scale is five inches long and hand drawn from recognized standards, the moving parts working on hardened steel pivots in Jewel bearings. Standard finish of instruments—polished nickel face, black or dead nickel background and japanned iron pot.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED MAY 30, 1905.

Electric Railways and Appliances.

790,886. Insulated Rail-Joint. Selden S. Deemer, Reading, Pa. Filed Aug. 15, 1904.

790,931. Trolley-Catcher. Lucean B. Stanley, Collinwood O. Filed July 22, 1904.

790,937. Trolley-Wheel. Richard Voltz, Michigan City, Ind., assignor of one-half to Otto Ohming, same place. Filed Feb. 21, 1905.

790,957. Insulating-Support for Third Rails. Ed W. Farnham, Chicago, Ill. Filed June 27, 1904.

791,003. Railway Block-Signal System. Frank E. Button, New York City. Filed Aug. 12 1904.

791,012-013. Strain and Supporting Device for Electric Railways. Harry P. Davis and Theodore Varney, Pittsburg, Pa., assignors to the Westinghouse Electric & Manufacturing Company. Filed Oct. 19, 1904, and Jan. 23, 1905.

791 031. Supporting Structure for Trolley-Wires. Budd J. Jones, Chicago, Ill., assignor to the Westinghouse Electric & Manufacturing Company. Filed April 2, 1904.

791,079. Rail-Clip for Third-Rail Insulators. George L. Courtenay and William Courtenay, New York City. Filed Aug. 27, 1904.

791 082. Trolley-Wire Hanger. Harry P. Davis and Theodore Varney, Pittsburg, Pa., assignors to the Westinghouse Electric & Manufacturing Company. Filed Oct. 19, 1904.

791,086-087. Self-Aligning Bearing and Universal Joint. Isidor Deutsch, Montreal, Canada, assignor to the Electric & Train Lighting Syndicate, Limited, same place. Filed April 30, 1903, and Oct. 24, 1904.

791,091. Brake for Trolley-Wheels. Johan E. Gamalielson, Kaumana, Hawaii. Filed Oct. 8, 1904.

791,178. Trolley-Wire Switch. Joseph T. Bunn, Washington, D. C. Filed Aug. 3, 1904.

791,191. Trolley-Guard. Mathias Hartz, Pittsburg, Pa. Filed Feb. 27, 1904. Renewed Nov. 2, 1904.

791,228. Electric Railway Signal or Alarm. Earl L. Tatum, Washington, D. C., and James W. Tatum Durham, N. C., assignors of one-half to Robert B. Boone and John W. Smith, Durham, N. C. Filed Sept. 2, 1904.

791,279. Trolley. George V. Miller, Irwin, Pa. Filed April 7, 1905.

Electric Lights and Appliances

790,940. Adjustable Suspending Device for Electric Lights. Arthur B. Wass and William Whitaker, Jr., Oakville, Canada. Filed July 14, 1904.

791,020. Extensible Support for Incandescent Lamps. Peter Forg, Somerville, Mass. Filed June 4, 1903.

791,253. Regulating Means for Electric Lamps. Albert G. Davis, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 18, 1902.

Electrical Machinery and Apparatus

790,883. Electric Fuse or Cut-Out. Leonard B. Buchanan, Woburn, Mass. Filed March 20, 1905.

790,917. Electrical Measuring-Machine. Franklin J. Perkins, Woburn, Mass., assignor to Vaughn-Rood Machine Company, Portland, Me. Filed Sept. 17, 1903.

790,941-942. Electric-Power System. James E. Weaver, Allegheny, Pa., assignor to the Weaver Electric Fire Engine Company, Pittsburg, Pa. Filed April 27 and Oct. 21, 1904.

790,983. Switch for Electric Circuits. Benjamin P. Rucker, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Oct. 8, 1904.

791,021. Transformer. Charles Le G. Fortesque, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 30, 1903.

791,085. Thumb-Piece for Electrical Switches. Frank C. De Reamer, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 9, 1902.

791,116. Control of Synchronous Machines. John B. Taylor, Schenectady, N. Y., assignor to the General Electric Company. Filed Oct. 17, 1904.

791,124. Controller for Electric Motors George Baehr, McKeesport, Pa., assignor to the National Tube Company, Pittsburg, Pa. Filed Feb 10, 1905.

791,180. Electric Motor for Automobile Vehicles. Eugenio Cantono, Rome Italy, assignor to Giovanni Mazzacorati, New York City. Filed Aug. 11, 1902

791,182. Thermostatic Circuit-Closer. Albert D. Catwood, Chicago, Ill. Filed Aug. 12, 1904.

Telephones and Telephone Apparatus.

790,945. Telephone-Transmitter. Walter L. Wilhelm, Buffalo, N. Y. Filed March 4, 1902.

790,952. Telephone-Mouthpiece Protector. Joseph M. Carrere Allentown, Pa. Filed Sept. 12, 1904.

Miscellaneous.

790,966. Indicator for Signal Transmitters. George W. Lorimer, Piqua, O. Filed July 22, 1902.

790,975. Electric Spark-Gap or Interrupter. Earle L Ovington, Boston, Mass. Filed Feb. 11, 1905.

791,103. Telegraph Key and Switch. Thomas J. McAdams, Annapolis, Mo. Filed May 19, 1904.

791,113. Electric Door-Opening Device. Frank Staehle, Newark, N. J. Filed Feb. 10, 1904.

791,114. Electric Signaling Indicator. Wm. Starkey Chicago, Ill. Filed Feb. 6, 1905.

791,285. Electric Boat or Launch. Harlan Page, Germantown, Pa. Filed March 26, 1904.

791,305. Art of Separating Gold or Other Diamagnetic Metals, Louis T. Weiss, New York City. Filed Aug. 26, 1903.

791,350. Storage Battery. Roderick Macrae, Chicago Ill. Filed Aug. 4, 1904.

791,413. Telegraphic Transmitter. Alfred C. Gilmore Chicago, Ill. assignor to James H. Peirce, truste same place. Filed Jan. 29, 1902.

791,429. Electric Block-Signalling System. William M Murphy, New York City. Filed Aug. 31, 1904.

791,435. Electric Speed-Limiting Device. Bertus 3 Barlow, Manchester, N. H. Filed Dec. 9, 1904

THE TELEPHONE WORLD.

New Company Offers Big Inducements to New York.

An application was made on Friday for a franchise to open war upon the telephone monopoly in this city with 5-cent calls and greatly reduced prices for residence service. The application was one of a half dozen which were laid before the Board of Estimate and Apportionment. It was received and the board set June 30 as the date for a public hearing on it.

The company making the application is the Atlantic Telephone Company. The officers and backers of the concern are almost all out-of-town men. Joshua D. Powers, president of the State Trust Company, of Louisville, Ky., and president of the local telephone company in Louisville, is president. Prominent business men of Pittsburg and other cities are mentioned as being interested in the company.

The promoters said that they had found a demand for 250,000 telephones in the city. "Our idea," it was said by the promoters of the company, "is to popularize the telephone and make it as generally used as gas and water."

The rate announced by the company is 5 cents for outside calls, $66 for residence rate, with unlimited service, and $108 for business office rate with unlimited service.

For compensation to the city the company offers to give the free use of 500 telephones and to pay the city 1 per cent. of the gross receipts for the first two years, 2 per cent. for the next three years, and 4 per cent. for the next 20 years. The franchise asked for is to run 25 years.

The directors of the Rochester, N. Y., Telephone Company will take action soon that will result in the purchase of a controlling interest in the Independent Securities Company of Utica. This will be another step in the forming of a combination of the Independent telephone companies of this State. It is said that the next company to be taken into the combination will be the Syracuse Telephone Company. Recently General Manager F. M. Potter, Jr., said that such was the intention, but that the details had not yet been worked out.

The Market Gardeners' Telephone system of Bloomington, Minn., has been sold to the Fisher system of Shakopee. The Shakopee system, which uses the Northwestern to Fort Snelling and Minneapolis, has been greatly needed by the market gardeners in Bloomington, as it gives them ready communication to the fort and the twin cities.

The Mount Vernon, Wis., Telephone Company has increased its capital from $2,000 to to $10,000. G. G. Stamm, president, and J. S. Donald, secretary.

A complete telephone system, touching all the coal mines of the Pratt City, Ala., division of the Tennessee Company is being installed.

The telephone poles are being set in Floyd Hill, N. Y., and the company promises to have the line in working order on before July 1.

A telephone line has been completed between Paris and Rome, and will soon be in operation between the French and Italian capitals.

Street Telephones for Public Service.

According to a Cincinnati, O., paper, one of the telephone companies of that city is about to try a plan of public service which is in operation in Europe, reaching the highest degree of efficiency in Norway and Sweden. The board of public service has granted the company a right to erect a short iron pole in front of the Traction Building, on which will rest a telephone box, similar in appearance to a fire-alarm box. It will be a public station and is intended to save time for those in a hurry. If the trial proves a convenience to the public, application will be made for other stations in various parts of the city.

Telephone Bids Wanted.

The Secretary of the Interior has issued a call for bids, to be opened June 26, for the construction and completion of a telephone system, about 16 miles in length and having four telephone stations, in connection with the Belle Fourche project, near Belle Fourche, S. D. Specifications, forms of proposals, and particulars may be obtained from the chief engineer of the Reclamation Service, Geological Survey, Washington, D. C., or the engineer in charge of the project, Belle Fourche, S. D. All bids should be addressed to the last mentioned official.

Some time during the present month the chief of the Signal Corps of the United States Army will issue a call for sealed proposals for furnishing the Signal Corps with about $75,000 worth of telephone apparatus. Models of practically all this equipment are now on exhibition in the model room of the Signal Corps in the Lemon Building, Washington, D. C.

The Terril, Ia., Co-operative Telephone Company has bought the telephone system heretofore operated by the Midland Telephone Company, of Milford, and took possession June 1. The officers of the Terril Company are: President, D. A. Daniels; vice-president, T. J. Randolph; secretary; D. E. Neville; treasurer, W C. Edmunds; directors, Martin Adson, David Woods, Ole Pingerson and G. W. Nefzger.

The Mt. Vernon, Me., Telephone Company was lately formed to do a general telephone business in the towns of Mt. Vernon, Readfield, Fayette, Vienna and Rome, in Kennebec County, and Chesterville, New Sharon and Farmington, in Franklin County, with $5,000 capital stock. The officers are: President, C. W. Mansur; treasurer, R. W. Leighton, both of Mt. Vernon.

The certificate of incorporation of the Tracy Creek, N. Y., Telephone Company was lately filed with the county clerk. The company is capitalized at $1,000. The directors are L. A. Mason, George Morton. Alex. Webster, B. C. Plough, Fred Wood, F. D. Brimmer and Oren Knight, all of Tracy Creek.

Congress has passed a bill empowering President Palma to grant at public letting a concession for a long-distance telephone service in Havana, Cuba. A guarantee of $50,000 will be required.

Telephones for Ships.

Two very elaborate telephone systems are being installed on the steamer Dakota, being constructed for the Great Northern Company. One is an exchange of the ordinary private plant type, which places the occupant of each room in communication with 150 other stations in different parts of the boat, and the other is an intercommunicating system which is made use of in the boat's administration. The officers, in making use of the latter do their own switching. It will largely supplant the gong and jingle system and the marine telegraph. It extends between the navigating and the engine room stations.

The stations are the bridge, the after-bridge, the crow's nest, port and starboard engine spaces, wheelhouse, chief engineer's room, chief electrician's room, central electric-lighting station and the dynamo shelf.

The six exposed stations have waterproof instruments. The holding case is of copper. The talking and listening parts are connected, so that all the officer or sailor has to do is to put the receiver to his ear. A great deal of ingenuity has been exercised in the construction of the instruments in such a manner as to exclude the water and moisture of the air.

Under the new order of things, when the lookout, high up in the crow's nest, sights an object on the sea, instead of raising the cry as he did formerly, he will simply open a copper telephone box and transmit the intelligence over the wire.

A Wire Fence 'Phone Line.

News from Stroudsburg, Pa., states that the Sugar Hollow Wire Fence Telephone Line is now in successful operation. Farmers living in the western part of Monroe County built it for their own convenience, and the line extends five miles.

There are a number of 'phones connected, and the farmers are elated over the unique wire fence telephone service. It has no stockholders, no superintendent, no officers of any kind, and everybody is perfectly free to use it, repair it, extend it and prize it as his own.

The Lyon County, Kan., farmers who are interested in the different rural telephone lines, held a recent meeting at the court house for the purpose of organizing the different lines and putting them under one management. The farmers are making a fight for the 50 cent rate granted them by the passage of a law to that effect by the last Legislature, and are combining with a view of obtaining it. The officers elected were: President, George Plumb; vice-president, E. B. Grant; secretary, Richard Spiker; treasurer, W. C. Jones.

A new manufacturing plant is to be established in Gallatin, Tenn., in the near future by J. T. Durham and W. W. Pardue, who will erect a plant for the manufacture of oak, locust and mulberry telephone, telegraph and electric light insulator pins and brackets. The capacity of the plant will be from 8,000 to 10,000 per day.

Telephone service has opened up on the Crews line in Buda, Tex. This company is operating six lines. L. Crews is the owner.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Albany, N. Y.—A certificate of the incorporation of the All-Counties Gas, Electric Lighting, Power, Heating & Illuminating Company, which proposes to carry on operations particularly in the County of Kings, has been filed with the Secretary of State. It has a capital stock of $ 0,000, and its directors are Edwin R. W. Potter, of Flatbush, and Henry E. Gaest and Alfred C. Cooper, of Brooklyn.

Columbus, O.—J. M. Butler, city solicitor, and his first assistant, David Keating, are looking over electric lighting conditions in other cities. This city is now endeavoring to establish a uniform rate for electric lighting and Mr. Butler has the matter in charge, to ascertain methods in vogue.

Del Rio, Tex.—The Del Rio Electric Light & Ice Company, capitalized at $20,000, has been formed by J. G. Darden, of Jericho, and John M. Gray, of this city.

Dexter, N. Y.—The Dexter Electric Light & Power Company has been organized to furnish light and power to various towns and villages in Jefferson County. Its capital stock is $100,000 and directors, Edward Hunter and Catherine J. Hunter, of this place, and Celestin C. Burns and George H. Burns, of Watertown.

Glenwood, Wis.—Plans for a local electric light plant are being prepared.

Higginsville. Mo.—Plans have been completed for the erection of a new electric light plant to cost $28,000, at the Confederate Home in this city.

Livingston, Mont.—This town is about to have a new electric light plant.

Luverne, Ala.—This town will have electric lights not later than October 31.

Lynn, Mass.—A reduction in the price of electricity, announced by the Lynn Gas & Electric Company, is to take effect July 1.

Meredith, N. H.—The Meredith Electric Light Company has filed articles with the Secretary of State increasing its capital to $9,000.

Milwaukee, Wis.—An investigation of discrimination in rates for commercial lighting in this city, was recommended by the council finance committee at a recent meeting.

New Castle, Col.—The Henry Electrical Corporation of Denver has purchased the Peter Kinney electric light plant of this city, and has commenced the work of overhauling the plant and remodeling it along more improved lines. New machinery throughout will be installed.

New York City.—The Murray Hill Public Service Company, of New York, has been incorporated to supply gas and electricity. Its capital stock is $10,000. James Cremmins, of Pelham Manor; J. W. Roche, of Pelham Heights, and L. C. Cremmins, of this city, are the directors.

Potsdam, N. Y.—The Raquette Valley Electric Light & Power Company, capitalized at $5,000, has been incorporated by George E. Willmarth, Lewis C. F. Hall, Henry H. N. Baker, John F. Butler and Frank E. Timerman, all of this place.

Rock Island, Ill.—The Home Electric Light & Power Company of this city, with a capital of $10,000, has been incorporated by Robert W. Olmstead, R. S. Dart and others,

Sturgeon, Mo.—The $5,000 electric ligh bonds, issued by this city, were sold to ex-Governor Lon V. Stephens, of St. Louis.

Tallapoosa, Ga.—Messrs. Gelder and Black will erect a thoroughly up-to-date electric light plant here.

Upton, Mass.—The question of electric lights is being agitated here.

Warren, Ark.—The Warren Light & Water Company has been chartered for the purpose of erecting an electric light and power plant. Its capital stock is $20,000, and officers, Fred L. Purcell, president; W. J. Savage, vice-president.

STREET RAILWAYS.

Abilene, Kan.—Plans to build an electric railway line from this city to Fairbury, Neb., to take in Clay Center and Washington, are almost completed by capitalists here. It will be called the Golden Belt Electric Line, and a charter will be secured shortly.

Ashland, Neb.—The Omaha, Lincoln & Beatrice Railway Company will establish an electric line through this city as soon as a right-of-way can be secured.

Atlanta, Ga.—This city is fast becoming the great electric railway center of the South, and it is promised in the near future six long-distance trolley lines, connecting with important points within the State, and even beyond its borders.

Auburn, N. Y.—The Auburn & Northern Electric Railroad Company, which proposes to construct a line about 12 miles long from this city to Port Byron, was lately granted by the State Railroad Commission rights to issue a first mortgage for $1,000,000, under which but $500,000 bonds can be issued at this time, and before issuing the remainder the company must apply to the State Board for its consent.

Barberton, O.—The Barberton, Wadsworth & Western Traction Company will build its own power house here.

Corbin, Ky.—A charter will be asked for the Jellico Electric Railway Company, which proposes to connect Jellico, Newcombe and this place, by an electric road.

Hannibal, Mo.—An electric road is to be built from here to Quincy as soon as possible.

Harrisburg, Pa.—It will not be long before Lancaster and this city will be connected by trolley line.

Jackson, Mich.—A party of Eastern capitalists, including Charles B. Holt, of New York; H. L. Randall of New Milford, Conn.; Charles Barlow, of New Haven; E. H. Spaulding, of New London, and Abram Paradise, of Brooklyn, have decided to finance a trolley line to be built between this city and Adrian. The new line will connect at Adrian with the Toledo & Western. The Adrian-Jackson line will be operated in conjunction with other lines, so as to allow through cars from Toledo to Lansing.

Powersville, Ia.—A new electric railway is to be constructed here.

Seattle, Wash.—Half a dozen projects for electric lines in different parts of this State, several of them paralleling steam roads, are now occupying a considerable part of the public mind.

Seymour, Ind.—John M. Duryee and Allen T. Russell, of Chicago, representing capitalists that city, are interested in the proposed electric railway line between this city and Columbus.

Tacoma, Wash.—Isaac W. Anderson, of this city, with several Walla Walla business men, have incorporated the Walla Walla Traction Company, with $200,000 capital, to build and operate a street railway in Walla Walla, which now has no street railway facilities.

Vallejo, Cal.—Prospects are said to be excellent for an early start on the work of building an electric rairoad between this city, Benicia, Suisun and Vacaville over the route of the franchises held by J. W. Hartzell. C. F. Archer, representative of the banking house of E. H. Rollins & Sons, has inspected the route and the resources of the country.

White Plains, N. Y.—The Harlem Railroad Company intends to begin the work immediately of transforming its system from Mott Haven to Wakefield into a four-track electric system. It is proposed to make Wakefield the terminal of the road until the line from that station through Mount Vernon, Bronxville, Tuckahoe, Hartsdale, Scarsdale and this place, has been prepared for the electric system.

POWER PLANTS.

Rhinelander, Wis.—The Rhinelander Power Company, composed largely of local parties, has completed arrangements to develop the water power of the Wisconsin River at a point about six miles below this city. A dam will be built, giving a head of about 24 feet and sufficient water is obtainable to develop an average of about 600 hp. In the rainy season more than 2,000 hp., at a conservative estimate, is obtainable.

Weleetka, I. T.—It is estimated that the construction of the power plant to be erected here, will cost not less than $1,500,000.

BIDS WANTED.

Kearny, N. J.—The common council has instructed T. C. Wildman, town clerk, to advertise for bids under plans and specifications adopted by that body for the erection of a municipal electric lighting plant. It is estimated that the plant will cost about $55,000. Bids for the construction work will be opened at a meeting to be held June 14. Plans for the structure are now on file at the town clerk's office and also at the architect's office.

Washington, D. C.—The Bureau of Supplies and Accounts, Navy Department, is inviting sealed proposals until June 13 for furnishing Eastern Navy Yards with the following supplies: Schedule 275, electrical supplies, wire, cable, incandescent lamps; schedule 277, telephones, electric elevator. Blank proposals can be obtained of the Bureau, or of the Navy pay office in New York.—Sealed proposals are being invited until June 14, for furnishing electric light fixtures for the House and Senate wings of the United States Capitol. Address Elliott Woods, superintendent, for blank proposals.—The War Department, through the office of the chief engineer, is inviting sealed proposals until June 20, for furnishing and delivering 36-inch searchlight outfits. Major S. W. Roessler will furnish proposal blanks on application.

NOTES FCR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15⅛@15¼c.; casting, 14⅞@15c.

The trustees of the Massachusetts Electric Companies voted to postpone action regarding the declaration of a dividend upon the preferred stock.

The Chicago City Railway Company has declared the regular quarterly dividend of 2½ per cent., payable June 30. Books close June 12 and reopen June 19.

The Broadway (New York) Surface Railroad second mortgage bonds, which mature July 1 next, will be paid on and after that date by the Morton Trust Company.

The Allis-Chalmers-Bullock Company of Montreal has obtained the contract to install a complete lighting plant for the town of Calgary, in the Canadian Northwest.

Superintendent Hedley, of the Interborough Rapid Transit Company of New York, says that the Bronx section of the Subway would be opened on the morning of June 15 without fail.

George W. Ely, secretary of the New York Stock Exchange, has received official notice of the Twin City Rapid Transit Company's proposal to increase its common stock by $5,000,000.

The regular quarterly rental of 1¾ per cent. on the stock of the Metropolitan Street Railway Company of New York will be paid July 15. Books close June 24 and reopen July 17.

The Woburn, Mass., City Council has passed over the Mayor's veto an order transferring the franchise of the Woburn Light, Heat & Power Company to the Edison Electric Illuminating Company.

According to a table prepared by Comptroller Grout the city of New York should receive for back franchise taxes and interest, 1900 to 1904 inclusive, as result of the franchise tax decision, $24,008,863.

Cleveland capitalists owning the New York & Long Island Traction Company, operating 34 miles of track connecting with the Brooklyn Rapid Transit Company, have sold the property for $1,450,000 cash.

A dispatch from Easton, Md., says the Diamond State Telephone Company and five other companies which have just voted to merge with it, are to be sold to the Bell Telephone Company of Philadelphia. The stockholders will meet June 30 to ratify the contract of the sale.

The directors of the United Railways & Electric Company of Baltimore have voted to pay no June interest on the income bonds, in view of the heavy expenditures for improvements. The last three coupons are unpaid. They are cumulative and back interest due amounts to $840,000.

It is reported that a settlement has actually been made with minority holders of $1,000,000 of the bonds of the Philadelphia & Lehigh Valley (Pa.) Traction Company on a cash basis of 45 for the bonds, and that they have been bought in for the reorganization committee of the Lehigh Valley Traction Company.

Judge Lanning, in the United States Court at Trenton, N. J., has directed E. C. Foster, receiver of the New Orleans Railway Company, to sell it to-morrow, unless there is paid to the New York Trust Company $22,557,324 for the bondholders. The receiver is to accept no bid amounting to less than $10,000,000.

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price June 3.
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	200⅛
Manhattan Elevated Railway	164
Metropolitan Street Railway	118⅝
Metropolitan Securities	78
Ninth Avenue	197
Third Avenue	126
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	63¾
Brooklyn City Railway	240
New Orleans Railway	4¼
Public Service Corporation (New Jersey)	121
Philadelphia.	
Consolidated Traction of New Jersey	83¼
Philadelphia Traction	99⅞
Union Traction	62¾
Boston.	
Boston Elevated	157
Massachusetts Electric Companies, com	16¼
do. do. do. pref.	36
West End Street, com	96¾
do. do. do. pref.	116
Chicago.	
City Railway	197
North Chicago	83
Union Traction, com	6⅝
do. do. pref.	45
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	13⅝
do. pref.	51⅛
Electric Boat, com	37
do. do. pref.	75
Electric Lead Reduction	¼
Electric Vehicle, com	17
do. do. pref.	21
Westinghouse, com	166
do. pref.	190
General Electric	173¼
Boston.	
Edison Electric Illuminating	245
General Electric	173¼
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	155
National Carbon, com	62
do. do. pref.	116
Philadelphia.	
Electric Company of America	11⅜
Electric Storage Battery, com	78
do. do. do. pref.	78
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	139¼
Western Telephone Company	18
New England Telephone Company	188¼
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210½
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93
Chicago Telephone Company	130
MISCELLANEOUS STOCKS.	
Otis Elevator Company	52
Consolidated Car Heating	64
Standard Underground Cable	200

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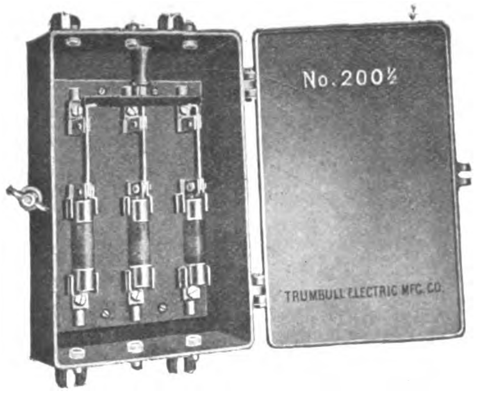

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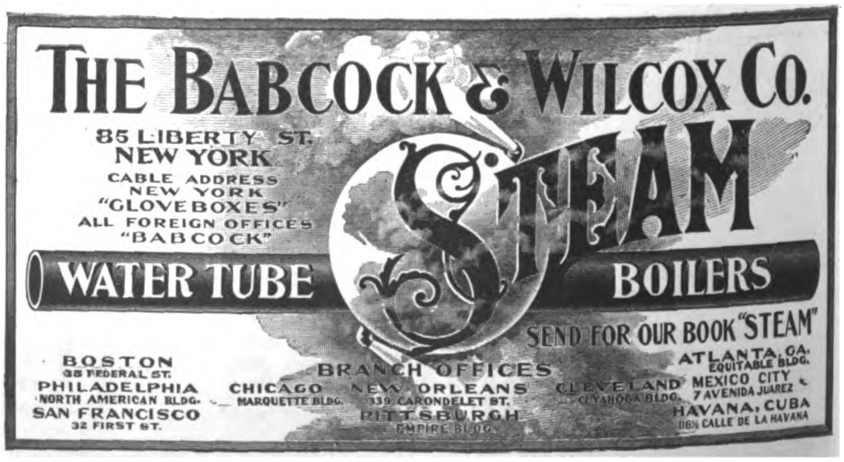

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ELECTRICITY.

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EDITORIAL NOTES.

New York to Chicago in Ten Hours.

Distance is now another name for time. A keen competition between railroad companies has raised the standard of excellence in rolling stock. The locomotive has been improved and the roadbed strengthened. Distance is being annihilated. Progress has been so rapid in the last ten years that even the most impatient hold their breath in surprise. Stephenson's venture has become a gigantic industry. It has transformed the dry land into the equivalent of great waterways. The freight of the country seeks the railroad; the farmers and the public regard it as their highway. Not only between small towns does this feeling exist but between the largest and most populous of our cities. From New York to Chicago was once considered a serious journey. In provincial days dangers beset the traveler on every side. Days were consumed in covering the distance. Now it is but a question of hours. Shall it be called the ultimate triumph of steam? Or shall we inquire as to what this ultimate triumph must be?

The distance is roughly 1,000 miles between New York and Chicago. About 29 hours, cut down to 24, was the customary limit of time in covering it. A speed of 40 miles an hour averaged up along the route. This, during the Columbian Exposition, was considered splendid railroading. Since then the locomotive has undergone great changes. The well-fortified roadbed, connecting that city and ours, invited a higher speed. A 50-mile an hour rate then presented the average. The latest reports show a capacity on the part of the Pennsylvania and New York Central to regularly operate an 18-hour train. This means an average speed of over 55 miles an hour. Now comes the question again, Is this the ultimate triumph? We think not. The locomotive can spin along much faster than this. Speed must be made subservient to the conditions of the road—whether it is clear or not, whether it can stand the rapid pounding of this great engine or whether it is safe to hurry forward so impetuously.

The suggestion is presented here that electric traction has set a new standard. The New York Central will use electric locomotives of 2,200 rated horse power. A speed of 90 miles an hour is easily attainable with a train of cars. Divide 1,000 by 90 and what is the result? A little over 11 hours. These are not merely figures, they are facts. The electric locomotives have been tested and tried. The system works like a charm. It would take a great deal of audacity to say when Chicago and New York will be the termini of an electric express system, but it is impossible to be blind to the truth. Ten hours to Chicago from New York is not so far off after all. Perhaps none have recognized this fact more readily than those from whom these results are to be expected—the steam railroad companies themselves.

* * *

The Peat Industry.

In view of the fact that coal is becoming scarcer and consequently higher in price each year, and that the time may come when other means of generating power will have to be sought for, a few words regarding the peat industry in this country will not be amiss.

As yet this industry is in its infancy. A few small operations are now going on, however, and a great number of prospective schemes are being exploited.

Several companies have been organized in the Middle and Northwestern States to produce peat fuel by various methods.

Some of these are building plants to operate during the summer of 1905. Others do not seem to have advanced beyond the prospectus stage. Many of them promise extraordinary profits by the use of patented processes, often involving the use at some stage of electrical devices.

Besides various plants in Canada and Mexico, mention is made of certain plants in the United States. The Pompton Fuel Developing Company is producing machine peat near Lincoln Park, N. J., and sells all its product to local consumers. Its success on a small scale will probably result in building a much larger plant this year. The machinery in use was imported from Germany and includes a Dolberg breaker and mixer. This company controls a large acreage of peat land in the vicinity of Pompton Plains, N. J. Another plant is in operation near New Rochelle, N. Y., by the Peat Koal Company of New York, which uses a Schlickeysen machine. At Orlando, Fla., machine peat is manufactured on a machine designed by Mr. T. H. Leavitt of Boston. A company has been organized in California to manufacture briquettes composed of peat and oil. Some tons of fuel have been made and tested, both for domestic and steam-raising purposes.

* * *

Marconigrams Between Express Trains.

One of the most interesting features of the twentieth century is its surprises. Take it as you will, we are always guessing as to the next move in the scientific or political world. The latest fact come to light is the equipment of trains between St. Louis and Chicago with "wireless" outfits. The Alton route has made a series of experiments in the past, which have culminated with such success that it is expected the company's efforts will lead to the establishment of a permanent system of this character on all express lines. The influence of this application of "wireless" to train service must not only be estimated with regard to the advantage to the passenger; it must be considered in connection with other important matters as well. The passenger, of course, can transact his business on the train if he chooses, remaining in touch with his office force however fast the train is moving all the way out. This is a great advantage to our captains of industry, whose souls are torn with doubt between stations when important affairs are in progress. But perhaps the best application of this splendid invention is that which is devoted to the protection of the passenger himself. This is where the greatest good may be done. It is easy to see how safe high-speed trains would become if some means were provided by which emphatic signals are rung when they approach within a few miles of each other. The casualties of steam roads are fresh in our minds. England has always protected herself in one particular respect by refusing to allow roads to cross each other on the same level—one goes above and the other below. Accidents are very rare in consequence. But American jurisdiction is not uniform. One State permits what another refuses. For this reason accidents are almost inevitable unless the greatest foresight is employed, particularly where freight lines and passenger trains occupy the same sections of track.

Let the "wireless" become as practical in its application as reports indicate and all locomotives will be equipped. The terrible loss of life and bodily injury resulting from collisions would thereby be reduced to a minimum. This mysterious signal from around a curve in the road, from a train delayed a few miles ahead, or from one behind rushing forward at a higher speed would be like a guardian angel in its watchfulness. There are few inventions that hold out such promise as this, few in fact that possess the merit to meet a dangerous situation so promptly. The increasing activity in our commercial centers has made time of the greatest possible value and led to head-long speeds on our trunk lines, but what business man would feel justified in running a life risk unless such provision were made on the journey that every element of chance is reduced to a minimum. An automatic signaling device, operative by a near-by train, would effectively solve this great problem. The blessed era of wireless telegraphy is only beginning.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

New York City will probably be selected as the place for holding the next convention of the National Electric Light Association.

◆

A 48-inch water main burst Sunday afternoon at Park avenue between 41st and 42d streets, New York, and sent torrents of water into the Subway beneath. It was necessary to shut off the power, stopping traffic for over 24 hours.

◆

The following appointments have been made for Cornell University at Ithaca, N. Y.: Mr. G. S. Macomber, assistant professor of electrical engineering; Mr. A. M. Buck, Jr., instructor in electrical engineering, and Mr. H. H. Cochrane, instructor in experimental electrical engineering.

◆

The Liege International Exhibition in Belgium was recently opened under the auspices of King Leopold.

◆

There are fourteen establishments in the State of Michigan for the manufacturing of electrical machinery, apparatus and supplies with a combined capital of $413,732.

◆

The Pennsylvania Railroad Company has begun the construction of the first experimental electrical engine at its Juniata shops at Altoona. If it proves satisfactory it will be used on the company's New York subways and Long Island connections.

◆

To demonstrate how little danger there is in electrical force when properly handled, Prof. Elihu Thomson of Lynn, Mass., permitted a half-million volts to pass through his body Thursday. He did not display the slightest tremor or experience any physical discomfort from the test. Prof. Thomson used a special apparatus in making the test. When the current was turned on, there was a flash from the finger tips and great sparks flew into the air, illuminating two incandescent lights that were held two feet from the fingers.

◆

The capital invested in electric lines in the United States, including street railways is $2,127,634,000.

◆

Last week, Thursday, for the first time in the history of railroading, wireless telegraph messages were successfully transmitted to and from an express train that was running at a rate of 50 miles an hour. The test was made on the Chicago & Alton Railway, between Chicago and St. Louis, messages being sent from Chicago to officers of the road traveling on the train, and every telegram was successfully transmitted. The observation car on the train was equipped with wireless apparatus, and while running nearly a mile a minute messages were received from President Felton, who was in the general offices in Chicago, and replies sent back from the train without the slightest hitch. So successful was the experiment that it was decided to equip at once all Alton trains running between Chicago and St. Louis with the wireless apparatus.

PROCEEDINGS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION AT DENVER, COL.

The Denver-Colorado Springs convention of the National Electric Light Association was a great success, and our representative writes that the large attendance—over 1,300—surprised the old-timers.

The first session of the convention was called to order at 10 A.M. Tuesday, June 6, at the Brown Palace Hotel, Denver, by President Davis, who said:

Gentlemen—The 28th convention of the National Electric Light Association will please come to order. I have the honor of introducing the Hon. Robert W. Speer, the Mayor of the City of Denver, who will deliver an address of welcome.

Mayor Speer's welcome to the convention made a happy impression. The mayor concluded his address as follows:

"In behalf of the men and women of this city, I want to extend to you the hand of hospitality, the freedom of our city; good wishes, and kind thoughts for your comfort and happiness while here and for a longing to return when you go away. Gentlemen, Denver is your—the gate is now wide open; walk in and help yourselves." (Applause).

President Davis—Gentlemen, I am sure we all appreciate the hearty welcome extended to us by Mr. Speer. The good things he said about Denver in his address are some of the reasons which induced us to select Denver as our place of meeting. We thought it would be a good idea and be an education for many of our members to come West, and after listening to the eloquent remarks of the Mayor and anticipating the pleasant experiences we will have during our stay in Colorado, I am sure we have made no mistake in selecting Denver-Colorado Springs as our place of meeting. I wish to thank Mayor Speer, on behalf of the Association, for his address of welcome.

President Davis then read his address which was in part as follows:

ADDRESS OF PRESIDENT.

"For the first time in the history of the National Electric Light Association, its annual convention will be held west of the Missouri River, and no more typical city of the West could have been selected than the progressive municipality of Denver, and no more beautiful spot than Colorado Springs.

"The interest of the central station, considered as an industry, is what has lately received the best work and thought of your association; the vital questions being no longer pre-eminently those of management or type of plant, but rather those relating to the stability and legitimate earning power of the industry.

"The one great and constant menace to the industry is unwise, burdensome and restrictive legislation by the municipality and the State. The right to tax is the power to destroy. The power to regulate contains the germ of the danger of confiscation in whole or in part. The regulation of the industry by a commission with powers such as are vested in the Gas and Electric Commission of the State of Massachusetts, may be proper and satisfactory as safeguarding both the rights of the public and of the investor. But regulation by a commission brought into being by a manufactured public sentiment, and having its inception in politics and not primarily or honestly intended to remedy any admitted public oppression, or to properly regulate the use of public franchises, cannot be fair either to the public or to the investor and must result in gross injustice to the industry.

"The association should not be passive while laws placing the industry under the regulation of commissions are passed by the several States, without making proper suggestions whereby such laws would be made reasonable and uniform in their provisions. Nor should it permit, without protest, the passage of any laws admittedly unduly restrictive and burdensome. The object should be to have the general laws of the several States relating to the industry conform to some standard, both fair to the public and to the industry.

"For one State to grant only very limited term franchises under burdensome restrictions, and for another—and possibly an adjoining State—to grant perpetual franchises without restrictions; for one State to reserve the right to fix and change the rate of charge for service rendered, and for another State to empower any municipality to make any rate it may see fit, and to charge the same when, and as it pleases, cannot but injuriously affect the stability of the industry from the standpoint of the investing public. I would, therefore, recommend the appointment of a standing committee on legislation to aid in protecting the interests of our members should occasion arise.

"Another important question is that of municipal ownership, which, while as yet limited generally to the construction and operation of municipalities of plants for public lighting, is more than likely to result in the general attempt to engage in private or commercial lighting, in aid of the public lighting.

"By way of self-protection, the central station should more than live up to the obligation of its franchises; should furnish public lighting at reasonable prices, and serve the public so well that any agitation started for political or personal ends will not receive the support of a justly indignant public.

"As the basis of the argument in favor of municipal ownership is largely that of a reduction in the cost of public lighting to the taxpayer, we should be prepared to answer this claim—as can be done—by the concrete results of the operations of existing municipally operated plants.

"It is to be regretted that the League of American Municipalities have not accepted the proposition repeatedly made by the National Electric Light Association to join in a thorough and impartial investigation of the results of the operations of existing electric lighting municipal plants in this country. We know, but the public generally do not, that such results do not justify or support even a part of the claims made by the advocates of municipal ownership.

"The amendments to the by-laws adopted at the last convention, relating to various classes of members, have resulted in a satisfactory addition to our membership. Members, Class B, are officers or employes of member companies, and now number 117; members, Class C, are instructors and teachers of engineering and related sciences, and now number 39, and associate members, Class E, are officers or employes of associate member companies, and now number 68. The total membership is now 824 as compared with 583 one year ago.

"The Association of Licensed Manufacturers of Incandescent Lamps has appropriated the sum of $10,000 for the purpose of effectively co-operating with the central lighting stations of the country for the increased use and, in consequence sale of incandescent lamps. The plan contemplates its expenditure in two ways: First, to be helpful in stimulating central stations along advertising and new business lines; second, to assume the cost of preparation of an effectual and comprehensive plan of advertising and soliciting, which, in consequence, could be furnished by some central bureau or advertising agency at a very low cost. As the plan suggested would be of value to the central station industry, I would recommend that a committee be appointed to work in conjunction with the Association of Licensed Manufacturers of Incandescent Lamps.

"A committee should be appointed to consider and report on the proper method of grounding secondaries of alternating current distributing systems so as to minimize the risk and danger to property and life.

"While not strictly within the objects of the Association, it would be well for our members to consider the advisability of consolidating the street railways, gas and electric companies in any given locality, as not only would the public be better served, but the total investment would be more stable, and the results equally satisfactory.

"But few of us appreciate the tremendous power of the association; the great possibilities for good or evil, that rest in the direction of its policy, and the importance of the interests involved. Our relations to the great public, our customers; to the legislative power, to which we are all subject; to the municipality under whose franchises we operate; to the great manufacturers of apparatus and supplies; to the insurance interests with whom we must always maintain the most intimate relations; and last, but by no means least, to our stockholders and all others pecuniarily interested in the properties we manage, are the great and vital questions that are now uppermost. It will be for future administrations to deal wisely and conservatively with them."

The Secretary announced the following committee on the President's address: L. A. Ferguson, F. W. Frueauff, George R. Stetson, Samuel Scovil and S. T. Carnes.

The President—We will now receive the report of the Progress Committee, Mr. T. C. Martin, of New York, editor. Mr. Martin will also read the special report on the Tantalum lamp, prepared by Dr. Louis Bell, of Boston.

Mr. Martin—Mr. President and gentlemen, as my report as chairman of the Committee of Progress is in type, it seems hardly necessary to inflict upon you an exhibit of bad elocution. I would like merely to call your attention to the various heads of the paper and leave you to read it at your leisure. The statistics of the industry, as usual, are first considered, and one or two aspects of the growth of our industry in this country are briefly referred to. Emphasis is laid particularly by your committee on the cultivation of the small customer, suggesting that perhaps a little less effort be made in the direction of crowding out the isolated plant, and a little more energy be displayed in the cultivation of the small consumer. . . . My paper then considers some of the leading central station developments during the past year, and speaks particularly of such instances as Detroit, where Mr. Dow, our fellow member, is carrying out an extremely interesting and ingenious development. As Mr. Dow is here it will be interesting to have him develop and extend the information given in my brief notes on this subject. I then give consideration to the subject of old and new illuminants which I need not inflict upon you, except to refer to the fact that immediately after the presentation of this report I shall read Dr. Louis Bell's report on the Tantalum lamp. I give in my paper some scientific data in regard to the development and purpose of the lamp, but Dr. Bell's paper is vastly more practicable and vital. After treating of illuminants I go to the discussion of electric heating and follow that up with a few remarks on electric power in general and its special application to refrigeration.

Mr. Martin then presented the report of Dr. Bell.

President Davis—This paper is now open for discussion.

Mr. Arthur Williams, New York.—I think, Mr. President, the life of the Tantalum lamp has been too limited to enable us to have had any commercial experience with it. We have had a number on test, and these tests and reports of other tests, including the report we have just heard through Mr. Martin, promise I think a very marked improvement in the economy of incandescent lamps in the future. I am of the opinion that it makes very little difference to the consumer whether he buys part of his light in current and part in lamps, or all in current, and that with this lamp remaining at the present high price, $1 in Germany and perhaps $1.50 or $2 here, at present it will not be a serious competitor with the incandescent lamp as we now know it. As an illuminant it is certainly very interesting, and promises well for the future, but as there probably have not been more that 100 of these lamps in this country, and they have not been here long enough to be subjected to any kind of commercial tests I do not think it would be practicable to discuss the lamp in any commercial sense. I do not think, because of the high price at which the lamp is obtainable, that it will be immediately a competitor with the ordinary incandescent lamp, because a high lamp cost will make up, in the economy of the lamp, compared with the standard we now have.

The paper was also discussed by John F. Gilchrist, D. C. Farrand, W. H. Gardener, Jr., and A. C. Dunham.

President Davis then announced the following papers:

"The Paramount Importance of the Selection of Standard in Preference to Special Machinery," David Hall, Cincinnati. [Mr. Hall's paper is printed in full in this issue of ELECTRICITY.]

"Insulation Testing—Apparatus and Methods," C. E. Skinner, Pittsburg, Pa.

Mr. Hall's paper was discussed by several members and the convention adjourned until afternoon.

TUESDAY, JUNE 6—AFTERNOON SESSION.

President Davis called the convention to order at 2:30 o'clock and in rapid order the following papers and report were read:

"Automatic Synchronizing of Generators and Rotaries for Lighting and Power Systems," Paul MacGahan, Pittsburg, Pa.

"Notes on Rotary Converters and Motor Generators for Lighting and Power Systems," Louis E. Bogen, Cincinnati, O.

"The Organization of Working Forces in Large Power Houses," W. P. Hancock, Boston, Mass.

"Operating Features of the Curtis Steam Turbine," A. H. Kruesi, Schenectady, N. Y.

Report of Committee on Steam Turbines, W. C. L. Eglin, Chairman, Philadelphia, Pa.

A lengthy discussion followed the reading of Mr. Bogen and Mr. Hancock's papers and the convention adjourned until Wednesday morning.

WEDNESDAY, JUNE 7—MORNING SESSION.

The convention was called to order at 10 o'clock by President Davis and he requested that the two following papers be read:

"Series Alternating Current Motors for Industrial Work," Clarence Renshaw, Pittsburg.

"A New Type of Single-Phase Motors for Elevator Work," S. Percy Cole, St. Louis, Mo.

A joint discussion took place on both papers. Mr. Cole asked whether a 60-cycle motor could be wound for the same voltage as a 25-cycle motor, or for any voltage up to 600, and Mr. Renshaw in reply stated that the question is largely one of the size of the commutator bars required. The higher frequency requires a greater number of bars, making a mechanical difficulty in constructing the smallller sizes.

Other papers and reports submitted at this session were as follows:

"Long Distance High-Tension Transmission in California," John A. Britton, San Francisco.

Report, Present Methods of Protection from Lightning and other Static Disturbances, Alex Dow, Detroit, Mich.

Mr. Dow recommended that the association appoint a reporter to handle the subject.

"The Choice of an Insulated Cable," Wallace S. Clark, Schenectady, N. Y.

"The Nernst Lamp—Its Present Performance and Commercial Status," E. R. Roberts, Pittsburg.

In reply to a question Mr. Roberts stated that the tests on direct current lamps recently showed such favorable results that the company will distribute lamps for commercial tests by various central stations, and the results of these tests will determine whether these lamps will be marketed.

Mr. Arthur Williams said that he had discovered that the Nernst lamp did not materially interfere with the incandescent or the arc lamp, but fills a gap.

The convention then adjourned until 8 P. M.

WEDNESDAY, JUNE 7—EVENING SESSION.

The President rapped for order at 8 o'clock and called for reading the following papers and reports:

"Some Investigations of Induction Losses," E. P. Dillon, Colorado Springs, Col.

"Mercury Arc Rectifiers, P. D. Wagoner, Schenectady, N. Y.

The author of the paper gave a practical demonstration of the apparatus.

"Free Signs and Flat Rates," C. W. Lee, Newark, N. J.

Report, Advertising Methods, Percy Ingalls, Newark, N. J.

Report, Sign and Decorative Lighting, La Rue Vredenburgh, Boston, Mass.

Mr. John Craig Hammond, the well-known advertising manager for the Denver Gas & Electric Company, in the discussion brought forward many good advertising points, and was followed in the same way by Messrs. Ingalls, Hewitt, Lee, Rawlins, McCabe and Williams.

An amendment to the by-laws was presented by Mr. Scovil, making the retiring presidents members of the executive committee for one year after the expiration of their term. The President referred the matter to a committee composed of Messrs. Doherty, Hartman and Brice, and adjourned the convention until Thursday morning.

THURSDAY, JUNE 8—MORNING SESSION.

President Davis called the meeting to order at 10:05 o'clock, and said "I will ask Mr. Crouse to open the discussion this morning on the question of advertising."

Mr. J. Robert Crouse—The thing which I wish to present to this association is perhaps a little different from the papers which have been presented and which have been discussed. I have prepared a paper which is 17 pages long, but I will simply say that the advertising proposition involves the co-operative publicity by the manufacturers of electrical apparatus and supply, co-operating directly with middle men of all sorts, middle men being understood to include central stations, dealers and contractors. I undertake in the paper to justify the proposition which I present. The proposition would involve, if carried out as I suggest, the expenditure of about $287,000 by the manufacturers of apparatus and supplies. As one gentleman said, that sounds well and is a good thing if it works.

The subject of advertising was discussed thoroughly, a large number of members joining in the discussion.

The convention then adjoined until 2:30 o'clock.

THURSDAY, JUNE 8—AFTERNOON SESSION.

President Davis called the meeting to order at 2:30 o'clock. He said: "The first business will be the reception of the report on 'Wrinkles' by Mr. H. C. Abell, New York City. I thank Mr. Abell personally, and I believe all the members of the association will join with me, for the satisfactory manner in which his duties have been discharged and the report prepared.

The next business was the report on "Committee on District Heating," by W. H. Blood, Jr. of Seattle, Wash., chairman. Mr. Blood read the report.

The convention unanimously adopted Mr. Scovil's amendment to the by-laws, introduced in Wednesday's session.

President Davis—We will now hear the report of the Committee on Nominations.

Mr. Louis A. Ferguson—Mr. President, the Committee on Nominations desires to make the following report:

The New Officers.

For President—W. H. Blood, Jr. Seattle, Wash.

First Vice-President—Arthur Williams, New York.

Second Vice-President—Dudley C. Farrand, Newark, N. J.

For three members of the Executive Committee to serve three years—Charles L. Edgar, Boston; John Martin, San Francisco; Frank W. Frueauff, Denver.

President Davis—Gentlemen, you have heard the report of the Committee on Nominations; what is your pleasure.

Mr. H. C. Abell—I move that the Secretary be empowered to cast the ballot of the members present for the unanimous election of the members nominated.

The Secretary cast the ballot and the President declared the nominees elected.

Mr. Ferguson—I would move that the Executive Committee be recommended to select as the Secretary-Treasurer Mr. W. C. L. Eglin, of Philadelphia.

The motion was seconded and carried.

President Davis—Gentlemen, I have pleasure in presenting to you Mr. Blood, your new President. I can only bespeak for him the same kind consideration that has been accorded me. I believe he will receive during his administration the hearty support of all our members.

Mr. W. H. Blood, Jr.—Mr. President and gentlemen, they say that there is no State in the country like Colorado for having the lightning come out of a clear sky. It certainly came out of a clear sky when it struck me this time. This honor is entirely unexpected and I hardly know what to say. I appreciate it very highly. I realize my own shortcomings, and also realize that the only way I can make any success in holding such a high office in this association is by your hearty co-operation, and I ask that I may receive from you the hearty co-operation which you have given to your President in the past.

The Committee on the President's Address then reported, and the suggestions made were adopted by a rising vote.

The usual resolutions of thanks were presented and unanimously adopted, after which the convention adjourned.

At the executive session on Thursday afternoon the following business was transacted:

Report, Committee on Relations with Kindred Organizations, James I. Ayer, Chairman, Boston.

Report of Preliminary Draft of Committee on Rates and Costs, Charles L. Edgar, Chairman, Boston.

Report, Municipal Ownership, Arthur Williams, New York City.

Report of Committee on Standard Rules for Electrical Construction and Operation, Charles L. Edgar, Chairman.

Stevens Institute of Technology Commencement.

The Stevens Institute of Technology announces that the 33d annual commencement exercises will be held Thursday morning, June 22, at 10:30 oclock, in the Auditorium, Stevens Institute, Hoboken, N. J.

THE PARAMOUNT IMPORTANCE OF THE SELECTION OF STANDARD IN PREFERENCE TO SPECIAL MACHINERY.*

BY DAVID HALL.

The idea of this paper is to call your attention to the important advantages, to both purchaser and manufacturer, in the use of standard, in preference to special, machinery. This is not a case in which the manufacturer alone is benefited; the points of advantage are mutual. The purchaser in selecting standard machinery aids the manufacturer in producing a more efficient and more perfect machine at a lower cost.

The most successful power plants must be characterized by reliability and economy of operation. There must be machinery sufficient to meet all emergencies and the machinery should be of as simple construction as possible, as simplicity is the key to reliability and complications insure troubles. The experimental stages of machinery of all kinds are examples of how complicated apparatus can be made, while its ultimate success depends upon the eradication and simplification of the parts so that the machine as a whole is easily understood and easily operated. With the advent of a new machine, we say "how complicated"; when the same machine is perfected, we say "how simple." It is therefore to the advantage of the purchaser that machinery become standardized. If only one machine is built from each design, and we have an infinite number of designs, the result is an infinite number of experiments, and it is only after one of these machines is thoroughly tried and perfected that we have a machine which can be called standard. However, if we assume that no two machines that are purchased are to be alike, there would be no incentive for standardization. This paper refers to "standard machinery" as machinery that is regularly listed for sale by a reputable company, such machinery having been built and standardized. The first machine of almost any description is capable of being improved upon. Sometimes the improvements suggest themselves after a very short test, while other improvements may be made only after a long period of operation. In fact, it may be said that the longer a machine of a given type is operated, the more certainly can the good points be determined and the more pronounced are the bad features that are to be overcome. Consequently, it is positive that the purchaser has everything to gain, in so far as the operation is concerned, by selecting machinery that is standard and does not possess experimental features.

It is to the interest of the purchaser and operator of every machine to know that spare parts can be readily obtained, for in the operation of machinery in general there are certain to be requirements for new parts, made necessary on account of wear or accident, and it is usual that such parts are wanted on short notice. If the machine is standard, such parts are likely to be found in stock, or, at any rate, can be furnished quickly. On the other hand, if the machine is of special construction in part or throughout, there is great probability of delay, and such delay may be very expensive as well as annoying, in fact, a long delay may cost more than the machine is worth.

In the natural course of events in the operation of mills, factories and power plants, changes of help are continually taking place and there is no machine so simple that the experienced operator cannot produce better results with it than can the inexperienced. It is, therefore, of importance that machinery be of such a nature that it can be easily operated, and this point must not be overlooked in making machinery standard. The more machines there are in operation of a given kind, the more men there must be who are familiar with operating them, and consequently the easier it must be to obtain an experienced operator.

Delivery of machinery is usually second in importance only to price, and it is not a rare occurrence that delivery is even more important than price. That standard machinery can be delivered more quickly than special machinery needs no proof. At the same time it is not always so plain to the purchaser why a special request as to speed, exact output, or detail of construction of a machine may delay its delivery three months, whereas a standard machine differing only slightly from the specifications might have been delivered immediately. At the same time the standard machine might meet the requirements and do the work as well or better than the special machine. Change of designs, change of drawings, new patterns, new tools and new castings are matters that are given little thought or consideration by the purchaser, yet these are the things that keep the nonproductive element of a shop busy, make prompt deliveries impossible, and keep the management searching for profit when there is only loss. Do not overlook the fact that these numerous expenses, due to changes of design, must be paid for, either by the purchaser or the manufacturer, and it is often the case that only a part of these extra expenses are paid for by the purchaser, and the rest is made up by a sacrifice of the profit by the manufacturer.

A certain manufacturing company has made 100-kw. direct current generators at the following speeds: 100, 125, 150, 225, 240, 250, 260, 275, 580, 650, 750, 900.

To-morrow they may be asked to make a machine of still another speed. Why? Because the purchaser's specification is drawn so fine as not to permit of a standard machine. It is true that they may be so drawn as to fit one manufacturer's standard machines, but every other manufacturer, in order to meet the specification, must bid on a machine that is special to him. The purchaser therefore receives one bid on a standard machine and five bids on special machines. Does such a specification give the purchaser the benefit of standardization? Assume that the specification is drawn for a belted machine running at 800 r.p.m. Would not 750 or 825 meet the requirements? Had the specification been so drawn that each manufacturer could submit a bid on his standard machine, together with guarantees and full information regarding detail construction, then the purchaser or his technical adviser would have an opportunity of acting as a judge in the matter of selecting the particular standard machine that was best suited to his requirements—rating, price, guarantees, and details of construction all being considered. In other words, the purchaser should act as judge and not as designer.

Another point to which your attention is directed is the value of the investment. Expansion of business often necessitates larger machinery, and it often becomes necessary to dispose of the machinery on hand. The price that can be obtained will now depend upon how well the machinery is suited to the demands of some other purchaser. If you have a motor with a special shaft, a special end head, or a special foot, a sale at any price is difficult to make. At the same time there is always a market for standard machinery.

The price of machinery is usually a base of comparison in purchasing, but operation is the test of quality. Poor operation is dear at any price; it is therefore of interest to the purchaser to determine how he can best obtain full value for the money invested. Certainly not by asking for that which is special or out of the regular line. The development charges on all new machinery constitute a large item, and it is only by standardizing that development charges can be distributed. The purchaser should realize that in selecting standard machinery he will not be burdened with development charges, and he will have the advantage of all the refinements of manufacture whereby standard apparatus, in virtue of being made in quantity, is made both better and cheaper than it could otherwise be. It is therefore plain that the purchaser should make known his requirements to the manufacturer by stating fully the conditions to be met and the work to be done; by so shaping his requests that the manufacturer can offer to him apparatus that is standard and has been "tried out" in all its details. Each specific condition that the purchaser inserts in a specification reduces the probability of standard apparatus meeting the requirements.

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*Paper read before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11, 1905.

In other words, the purchaser in making inquiries for machinery should state all necessary requirements, but should carefully avoid the addition of unnecessary requests. If the specifications are so drawn, the manufacturer can offer the purchaser standard machinery with guarantees, and the price of the machinery may be considerably lower than if the purchaser had filled his specifications with a number of unnecessary conditions. Many specifications would be more to the advantage of both purchaser and manufacturer if they were cut short at the end of one page instead of being drawn out to the extent of twenty pages. Let the purchaser define the work to be done, and let the manufacturer prescribe the machine to do it. If the purchaser wants his machine made to order he may be sure that it will be too small in the waist or too long in the leg to suit his neighbor, and that he will have to settle a tailor's bill in addition to a manufacturer's cost.

ELECTRICALLY-DRIVEN ROLLER-BEDS AT THE PHŒNIX STEEL WORKS.*

Live rollers are empoyed in steel and iron works for transporting ingots, blooms, etc., from place to place, and for bringing the material to be rolled again and again up to the rolling mills after the latter have been reversed in direction. A considerable number of such live roller-beds, electrically-driven, are in successful operation at the Phœnix Iron and Steel Works in Laar, near Ruhrort (Germany). Part of the electrical energy generated is used for lighting the works and part is used for running a number of motors, including those for the roller-beds, while a 1,200 hp. motor for driving the rolling mills is in course of erection. The generating plant consists of three 1,000 hp. blast-furnace gas engines, each of which is directly coupled to a three-phase generator of similar capacity. Three additional 800 hp. sets are nearing completion, if they have not already been put into service by the time this article appears.

At present the Phœnix Works makes use of the roller-beds for feeding the ingots to the reversible cogging mill, for transporting the blooms to the bloom shears, for handling the material at the shears, and for transporting the material after having been cut. In addition, some further roller-beds are being put down in connection with the rail rolling mills, sleeper-rolling mills, etc.

Roller-beds for the Cogging Mill.—Live rollers are provided in front of and at the back of the cogging mill. Those in front have the following dimensions and weights: One stepped roller, having diameters of 1 ft. 7¾ in., 1 ft. 10 in. and 2 ft. ½ in., a length of 8 ft. 9 in. and weighing 9,800 lbs.; one roller, having a diameter of 1 ft. 5½ in., a length of 9 ft. and a weight of 8,700 lbs.; 10 rollers, each having a diameter of 1 ft. 5½ in., a length of 11 ft. 6 in. and a weight of 9,900 lbs.; one roller, having the same diameter, but 9 ft. 10¾ in. in length and weighing about 8,900 lbs.

The first two rollers at the back of the cogging mill are identical with the corresponding rollers at the front of the mill. These two live rollers are then followed by six others, which are of exactly the same dimensions and weight as the 10 rollers referred to above. All the rollers are solid and of forged steel. Their spindles have a diameter of about 7 in. The front roller-bed and the back roller-bed weigh, complete, about 65½ tons and 41 tons respectively, and these weights include the gear wheels and the countershafts, the latter being 6¼ in. in diameter. The cogging mill has to deal with about 1,200 tons of steel every 24 hours, the ingots weighing from 2.6 to 3 tons. Each ingot, therefore, requires about 3½ minutes for rolling. It is passed altogether from 20 to 24 times through the cogging mill in about two and a half to three minutes, according to its size. Each roller bed has thus to convey the block from 10 to 12 times to the mill during rolling. The motor equipment of each roller-bed consists of a 60 hp. 190 volt three phase motor, running at about 620 revs. per min., the frequency of the supply being 47 cycles per second. Motors and countershafting are installed in a pit which is suitably covered in so as to protect them from mechanical injuries. Fig. 1 represents a 30 hp. motor of the same design as the 60 hp. motors. The design and arrangement of the slip-rings is noteworthy and it will be seen that the motors are of the ventilated-inclosed type.

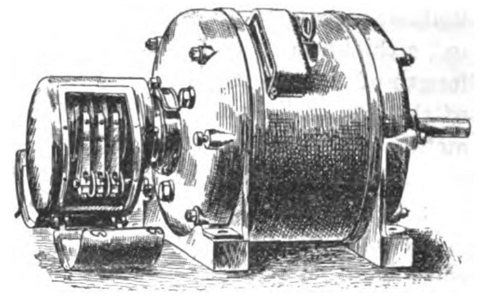

Fig. 1.
30 hp. Three-phase Motor for Driving the Live Rollers.

A platform has been erected above the front roller-bed, from which the operator can see what is going on in front and behind the cogging mill. The reversing controllers are installed on this platform. Fig. 2 shows their general design. They are, it will be noticed, of strong construction and have carbon contacts. At starting a resistance is inserted into the rotor circuit, this resistance being cut out in four steps. There is a special handle for reversing. Each motor is connected to the supply through a switch and a fuse, and each is powerful enough to impart to the steel block a speed of about 5 ft. 5 in. per second within from two to three seconds. Each motor is also capable of reducing the speed of a block from the maximum to zero and accelerating it again up to full speed in the other direction in from four to five seconds.

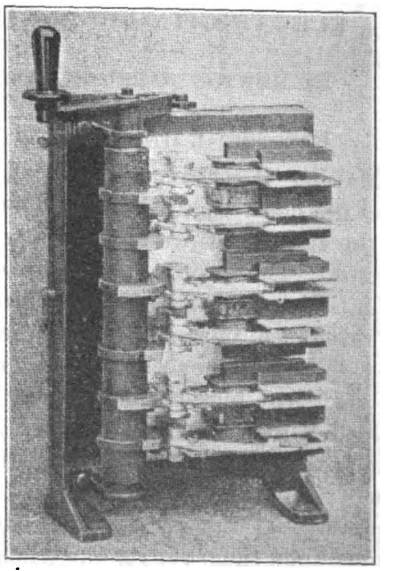

Fig. 2.
Type of Controller for Reversible Roller beds.

Belt Conveyors.—There are three belt conveyors, each of which is driven by a 30 hp. three-phase motor running at 700 revs. per min. As these motors need not be reversed, they are started by an ordinary rheostat with metal resistances.

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*From the "Electrician," London.

Roller-beds at the Shears.—The roller-bed in front of the shears consists of 15 hollow rollers of a diameter of 2 ft. 1½ in., a thickness of metal of 1⅛ in., and a length of 3 ft. 3⅜ in., and of two rollers of the same diameter and thickness of metal, but having a length of 2 ft. 5⅛ in. At the back of the shears are the following: Six hollow rollers of 1 ft. 3¾ in. diameter, a thickness of metal of 2 in., and a length of 2 ft. 3⅛ in., and 11 rollers having a diameter of 11⅜ in., a thickness of metal of 1½ in., and a length of 2 ft. 2 in. Blooms from the cogging mill are cut by the shears into 10 pieces on the average in from 2½ to 3 minutes. The front roller-bed is driven by a 30 hp. three-phase motor, while the back roller-bed is operated by a 60 hp. three-phase motor. Both motors run intermittently and at about 620 revs. per min. In design they follow the same lines as the motors referred to before, and the controllers, too, resemble in construction those alluded to above. A platform is erected at the side of the shears for the operator who is able to cause the blooms to be shifted very accurately. With relation to the shears it is said that by switching on and off quickly the material may be moved by as little as 5 mm. (0.2 in.) at a time.

ELECTRICITY LEAFLETS.

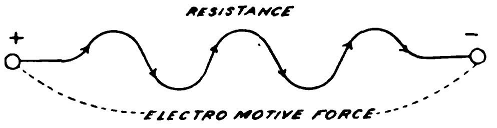
BY NEWTON HARRISON, E. E.

ELECTRICAL MEASUREMENTS.

Making measurements of electricity does not consist entirely of measurements of the amount of pressure or current in a circuit. The process is more extensive than this and embraces the measurement of resistance, power, induction, magnetic flux, etc. In other words, under the title of electrical measurements may be included a great variety of tests in electricity and magnetism, many of which are of such great importance that it may be said that the very science itself depends upon them for its existence.

Ohm's Law.—The corner stone of the science of electrical measurements rests upon a true knowledge of Ohm's law. As far as this is concerned, Ohm's law presents itself first in the familiar form so well expressed by the statement that "the current is proportional to the electromotive force and inversely proportional to the resistance." Then it appears under two other guises, in which, instead of the value of the current alone being given, the value of the resistance and EMF. are expressed in simple terms.

Forms of Ohm's Law.—The forms of Ohm's law are those in which the current, resistance and electromotive force are so related that when two are given the third can be found. For instance, when resistance and current are given volts are found; when volts and current are given resistance is found; when volts and ohms are given current is found. The three elements composing Ohm's law whose relationship must be expressed as indicated are:



Simple case of EMF. acting on a non-inductive circuit.

1. Resistance given in ohms.
2. Current given in amperes.
3. Electromotive force given in volts.

It must be remembered that when two are given to find the third, multiplication occurs once and division twice, as follows:

To get volts multiply amperes by ohms.

To get amperes divide volts by ohms.

To get ohms divide volts by amperes.

Here, it is observed, that to get volts, multiplication is necessary between the other two. On the other hand, to get either amperes or ohms the volts must be divided. There are, therefore, only two processes, multiplication and division—the multiplication of current and resistance, and, to get the other two values, the division of the pressure by either the current or resistance.

Problems in Ohm's Law.—To illustrate these applications the following cases are given: To find out how many volts are required to send 10 amperes through a resistance of 100 ohms. In this case the volts are to be found, and the two values given must be multiplied together:

Volts = amperes × ohms = 10 × 100 = 1,000.

The next case is to find out how many amperes will pass through a lamp taking 110 volts, whose resistance is 220 ohms. The other two cases, as stated, call for division. In this particular instance the amperes are to be known. According to the law

Amperes = volts ÷ ohms = 110 ÷ 220 = ½.

The physical fact to be kept in mind is that an incandescent lamp has a high resistance when cold and a much lower resistance when hot. A resistance test would show that the lamp when cold equals 450 ohms, while at incandescence the carbon falls to 220 ohms.

The third case is the one in which the resistance of a coil of wire is to be found which takes a current of 2 amperes and a pressure of 110 volts. When either current or resistance are to be found, division takes place as follows.

Ohms = volts ÷ amperes = 110 ÷ 2 = 55.

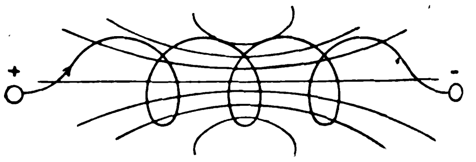
The methods employed in applying Ohm's laws to practical cases are given below in a concise form:

Volts divided }
" " } give amperes or ohms.

Volts obtained } multiply amperes by ohms.

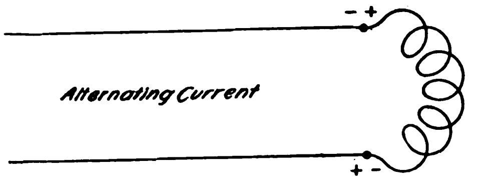
These are the simplest illustrations of Ohm's law as employed by electrical workers all over the world. They may be considered as the most important forms in which it appears. It undergoes other changes in alternating current theory, because of the fact that additional influences are operating besides those ordinarily appreciated. The above forms, while true, would therefore be inapplicable to circuits carrying variable currents.

Ohm's Law for an Instantaneous Current.—When a current is turned into a circuit for an instant and turned off, or when a current is first sent into a circuit, the current for a short period of time is not exactly equal to the volts divided by the ohms. There seem to be other influences at work which partially arrest the free flow of the current. It cannot be said that this influence is due to the resistance of the wire, because if this were only the case, Ohm's law would hold true in every sense of the word. The difficulty, however, is not so much inside the wire as outside of it. The extent of the influence playing upon the outside of the wire causes the difficulty. This, it seems, acts in such a manner that a current cannot be instantaneously sent into a wire at its full strength, neither can it be instantaneously cut short. The wire possesses the power of developing, through this external influence surrounding it, *an electromotive force of its own.*



A current passing through an inductive resistance and meeting with retardation.

When the blacksmith strikes the anvil, the hammer flies back. In a sense, when a current strikes a circuit, the circuit strikes back. The sound may be absent and there may be no visible signs of this reaction, but it is always there. From a scientific standpoint, it is stated that the magnetism around the wire, which sur-rounds it when a current flows, momentarily develops this counteracting influence. It acts against the *incoming* current, checking it, and naturally only permitting it to rise to its full value in a certain period of time; or it acts with the retreating current when the circuit is opened, augmenting its pressure at this last moment. It had been noted for quite some time, before an examination of the conditions had been made by eminent physicists and mathematicians, that rapidly changing currents did not seem to flow in obedience to Ohm's law. Neither did Ohm's law, as then understood, coincide in its results when applied to those obtained with a current turned rapidly on or off. The fact that the current took an appreciable time to rise to its full value and did not immediately cease in a circuit opened and closed, gave room for thought. It soon became evident that the simple form of Ohm's law for these conditions would not do. It could be correctly applied in the case of a continuous current but not in the case of either an *instantaneous* or an *alternating* current. Helmholtz interpreted Ohm's law in a new form, in which time is considered, and the influence external to the wire called self-induction. The Helmholtz equation, as it is called, is therefore a form of Ohm's law by which the current can be ascertained at any instant. It contains symbols expressing the physical conditions as follows:



An alternating current passing through an inductive resistance.

Current in amperes.
Resistance in ohms.
Pressure in volts.
Self-induction in henries.

System of logarithms called Naperian based upon a value e.

The Helmholtz Form of Ohm's Law.—Helmholtz gave Ohm's law as written, but he added a modifying clause, so to speak. Helmholtz states that the current is equal to the electromotive force divided by the resistance, as given by Ohm himself, but what he adds is true for the value of the current *at any instant.* Ohm's law states as follows:

Current = volts ÷ ohms, but if the ohms are not alone in governing the growth of the current, then the formula does not hold true. It will hold true, however, if the R is correctly stated; therefore Helmholtz adds a parenthesis by which Ohm's law must be multiplied and exact values are obtainable for any condition of the circuit or current. He multiplies E ÷ R by the parenthesis 1 — e raised to the minus R over L times t power; in other words, his mathematical genius enabled him to discover that if from E ÷ R, which gives the amperes under ordinary conditions, a value is subtracted equal to e with a minus exponent equal to $\frac{R}{L} \times t$, then the correct value of the current is obtained. In the formula given the verbal rendering would be as follows:

$$\text{Amperes} = \frac{\text{Volts}}{\text{Ohms}}\left(1-e^{-\frac{\text{Ohms of circuit}}{\text{Self induction of circuit}} \times \text{Time in seconds}}\right)$$

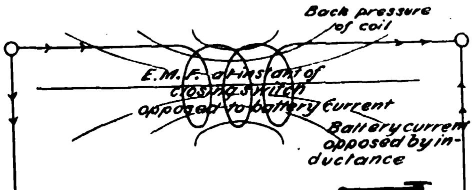
Written with symbols, which are merely the equivalents of the values stated above, Helmholtz's interpretation of Ohm's law for the current at any instant is

$$C = \frac{E}{R}\left(1-e^{-\frac{R}{L}t}\right)$$

To illustrate make
$E = 100$ volts.
$R = 20$ ohms.
$L = 2$ henries.
$t = 5$ seconds.

Then e with its exponent becomes equal to $\frac{1}{e^{50}}$, which is practically equal to zero. This would leave $C = E \div R$ or nothing to subtract. When the time during which the circuit is closed is prolonged, as in this case, to 5 seconds, the simple form of Ohm's law is only left to apply.

Form of Ohm's Law for Alternating Currents.—The influence of self-induction has been referred to in the Helmholtz form of Ohm's law. From this form of the law another interpretation has been obtained which is in a more practical form than the last. In this formula, the effects of self-induction and the frequent changes of the current are considered so that simple calculations can be made. When a current is started in a circuit, at that instant all of the disturbing effects transpire whether the current is continuous or alternating. If the current is alternating in character, the more rapidly it reverses its direction in a second, the more of this reaction takes place in the circuit; in fact, the extent of this impeding influence is given by the formula as follows:

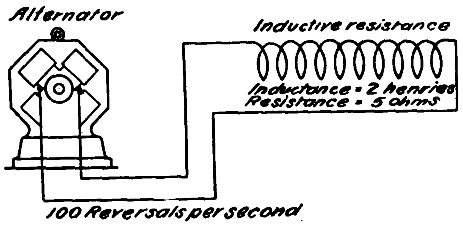

Back pressure of coil
E.M.F. at instant of closing switch opposed to battery current
Battery current opposed by inductance
-
+
Switch

Inductance opposing battery current at moment of closing the circuit.

The impedance = the square root of the resistance squared, plus the product of the self-induction squared, times 2 π, times the frequency squared.

If the symbolic representation of these facts is attempted in which
R = resistance in ohms,
L = self-induction in henries,
$p = 2 \times \pi \times$ the frequency per second,
I = the impedance.

Then $I = \sqrt{R^2 + p^2 L^2}$, or impedance $= \sqrt{(\text{ohms})^2 + (2 \times 3.1416 \times \text{freq.})^2 \times L^2}$. To carry this idea out practically the question might be asked, What is the impedance of a circuit in which the resistance equals 5 ohms, the frequency 100 per second and the henries 2? Then
$R^2 = 5 \times 5 = 25$,
$p^2 = (2 \times 3.1416 \times 100)^2 = 394{,}384$,
$L^2 = 2 \times 2 = 4$,
then $R^2 + p^2 L^2 = 25 + 394{,}384 \times 4 = 1{,}577{,}561$, and the square root of this number equals 1,256. The comparison of the effect of the resistance of 5 ohms and the effect of the impedance in total shows how resistance may be disregarded altogether when the frequency of an alternating current is high or the self-induction in the circuit is high. The resistance having been substituted for by the false resistance, Ohm's law for alternating currents will be



Alternating current meeting an impedance of over 1,200 where the ohmic resistance is only 5.

$$\text{Current} = \frac{\text{electromotive force}}{\text{impedance}}.$$

If there is no frequency, the last characters disappear in the impedance and only resistance is left. For instance, if there was no frequency $p^2 L^2$ disappears and the square root of R^2 is R. The formula then becomes $C = E \div R$. The three forms of Ohm's law as given by Ohm, by Helmholtz, and with respect to the spurious resistance or impedance, all become transformed into Ohm's original form when time is prolonged in one case, and the frequency or inductance disappears in the other.

WRINKLES.*

EDITED BY H. C. ABELL.

Locating Grounds in Buildings.

A handy device for locating the points where wires are grounded in buildings was made by taking a U-shaped yoke of iron and winding it on a coil of very fine wire and connecting this coil to a telephone receiver. When the yoke is brought in proximity to a wire carrying a current a buzzing will be heard in the telephone receiver, and grounds within the walls of a building can be located when carrying a current by moving the yoke along the wall. The method of locating a ground is as follows:

All the lights are turned off, and the main feed tested; if there is a meter, care must be taken to get beyond the meter, as the current taken by the potential coil is sufficient to make the receiver buzz. If a buzzing is heard it can be traced to one of the branches, and this can be followed along the walls until a point is reached where the buzzing ceases or is diminished. This is the point where the current is leaving the conductor, or the grounded point. This apparatus works on both alternating and direct currents, but better on the former.

J. F. DOSTAL, Denver, Col.

Using 50-cp. Nernst Lamps on a Direct-Current System.

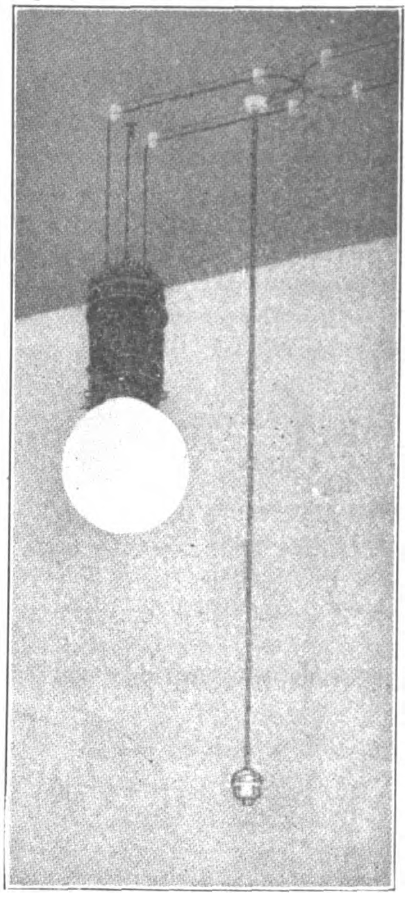
When the Nernst lamp was first put on the market I bought two single-glower, 220-volt lamps. I did not know that they were made for alternating current only. I very soon found that the glowers burned off the second or third time the current was turned on. I noticed that the glower always broke off close to the end where it was cemented to the platinum wire. As an experiment I wrapped the platinum wire around the broken end of the glower, about three turns, leaving the ball of cement on the end of the platinum wire, taking great care to squeeze this ball close into the glower, to take the greatest part of the heat from the glower. After splicing the glowers in this way I have succeeded in burning lamps of this type on direct current about 600 or 800 hours. The scheme, however, is not a commercial success, and I do not advise that it be patented.

E. A. ASPNES, Montevideo, Minn.

New Pendant Switch Device for Any Kind of Electric Light.

The pendant switch has a definite field of usefulness in both arc and incandescent lighting. It has heretofore been applied to incandescent lighting almost exclusively, owing to the inspection rules, which do not permit the use of a single-pole switch on arc lamps.

The pendant switch is, however, capable of as broad application to arc as to incandescent lighting when the device herewith illustrated is used. A standard double-pole, 10-ampere snap switch is fitted with a nickel-plated canopy, which serves to admit the wires to the switch and supports it by a knot made in the cord inside the canopy. The four conductors forming the double-pole switch loop are neatly brought together under one braid, the whole presenting a very neat appearance. The cord is suspended from the ceiling on any of the usual forms of ceiling block.



In wholesale establishment and stores, where it is impracticable to locate the switch near the arc lamp, it has heretofore been necessary to place all the switches in the cut-out cabinet at one end of the room. This makes it necessary for the salesman showing goods on a floor to go to the end of the room and switch on all the lamps which he will require in showing the customer the goods.

By the use of a double-pole pendant switch attached to each lamp he is able to show his goods effectively by turning the lamps on in each section as he comes to it, turning them off as he leaves the section.

Thus it becomes possible for many large establishments, who have not felt able to pay the cost of electric lighting heretofore, to use the superior light of the arc lamp for showing all goods which do not appear to advantage under other light.

The device is also made for use with a single-pole switch, and in this form is adaptable to all uses to which pendant switches have been put heretofore.

The double-pole type may be used on large incandescent clusters or fixtures, the single pole-type not being approved in Chicago for more than six 16-cp. lamps.

The expense of installing the pendant switch is much less than that of wiring to a position on the wall, in most cases. With the type of switch here shown the cost of the canopy is but a fraction of the cost of the standard snap switch.

C. H. STEWART,
Chicago Edison Company.

Flicker Interrupter.

A device, which may be called a "flicker interrupter," is proposed for use in connection with the demand system of charging, where it is impracticable or undesirable to install a demand meter. The instrument serves to interrupt the customer's service when the proper demand is exceeded.

This device is simply an electro-magnetic solenoid with a core which is extended downwards to form a plunger. This plunger enters into a steel cup containing mercury. The instrument is connected to one side of the customer's wiring at the service, one connection being made to the steel cup and the other (flexible) to the plunger.

When the customer's demand is normal, the plunger remains in the mercury, and the circuit is unbroken. If, however, the demand goes above the amount for which the instrument is set, the plunger vibrates in and out of the mercury, causing continuous interruption of the circuit. These interruptions will continue until the excess demand is cut out of the circuit.

LEONARD L. ELDEN, Boston, Mass.

New Electric Furnaces.

The Physical Society (England) recently held one of its meetings at the National Physical Laboratory, and Dr. J. A. Harker then described and exhibited some new types of electric furnace for the attaiment, in absence of noxious gases, of temperatures between 800 degs. C. and 2,200 degs. C. The conductor conveying the electric current is a tube of solid electrolytes similar in composition to the filament of a Nernst lamp. An essential feature is that, for many purposes, the usefulness and life of a furnace constructed in this way may be much increased by adopting a "cascade" system of heating; that is, the energy supplied may be divided, so that only sufficient is put through the tubular conductor to raise its temperature, say 1,000 degs. C. above its surrounding, the surrounding itself being maintained at 7,000 degs. C., thus enabling a temperature of 2,000 degs. C. to be attained in the tube without straining it unduly. The regulation of temperature in small furnaces of this type is so perfectly under control that very well defined melting-points may be taken with very small quanties of substance. The thermo-electric method has been used in these furnaces for determining the melting point of platinum, the mean result of the experiments giving 1,710 degs. C. ± 5 degs. C.

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*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11, 1905.

Annual Election of the New York Electrical Society.

The 24th annual meeting of the New York Electrical Society for the election of officers will be held at the Cafe Boulevard, 2d avenue and 10th street, Wednesday, June 14, at 9 P.M. The following nominations of the nominating committee will be submitted:

For President—W. S. Barstow.

For Vice-Presidents—H. G. Stott, Putnam A. Bates and Max Lowenthal. (Vice-presidents elected 1904 for two years are Albert F. Ganz, Louis B. Marks, W. S. Rugg.)

For Secretary—George H. Guy.

For Treasurer—H. A. Sinclair.

New York's Light Commission.

Governor Higgins of New York has appointed as Commissioners of Gas and Electricity James R. Sheffield, of New York; Lucien L. Shedden, of Plattsburg, and ex-Attorney General John C. Davies, of Camden. Each commissioner is to receive a salary of $8,000 per annum, besides being allowed $500 a month for traveling expenses. The commission will have offices in Albany, New York and Buffalo.

Julius E. Marsh Dead.

Julius E. Marsh, 64 years old, superintendent of the Underground Cable Company, 56 Liberty street, New York, was fatally injured Saturday morning by a train at Van Syclen street and Neptune avenue, Coney Island. He was taken to the Coney Island Hospital, but died shortly afterward. The deceased was inspecting some conduit operations when he was struck by the train.

ANNUAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

From present indications there will be a large attendance at the annual convention of the American Institute of Electrical engineers, to be held at Asheville, N. C., June 19 to 23. The following is the list of papers to be read:

"Appalachian Water Powers," by F. A. C. Perrine.

"Three-Phase Traction," by F. N. Waterman.

"Limits of Injurious Sparking in Direct Current Commutation," by Thorburn Reid.

"A Study in the Design of Induction Motors," by C. A. Adams.

"Choice of Motors in Steam and Electric Practice," by William McClellan.

"High-Potential Oscillations of High Power in Large Power Distribution Systems," by Charles P. Steinmetz.

The Constant-Current Mercury Arc Rectifier," by Charles P. Steinmetz.

"Heavy Electric Freight Traction," by C. De Muralt.

"A New Instrument for Measuring Alternating Currents," by E. F. Northrup.

"Motor-Generators and Rotary Converters," by W. L. Waters.

"Limits in Direct Current Machine Design," by Sebastian Sonstius.

"Electrical Features of Block Signaling," by L. H. Thullen.

"The Development of the Ontario Power Company," by P. N. Nunn.

"A New Induction Generator," by William Stanley.

"An Experimental Study on Commercial Transmission Lines of the Rise of Potential Due to Static Disturbances Due to Switching, Grounding, etc.," by Percy H. Thomas.

"Experimental Data Relating to Conductors and Underground Electric Cables," by Henry W. Fisher.

"Methods of High-Pressure Measurement," by S. M. Kintner.

"Weight Distribution on Electric Locomotives, as Affected by Motor Suspension and Draw-Bar Pull," by S. T. Dodd.

"Eddy Currents in Large Armature Conductors," by A. B. Field.

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ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JUNE 6, 1905.

Electric Railways and Appliances.

791,556. Trolley-Wheel. John Hensley, Huntington, Ind. Filed July 20, 1904.

791,633. Trolley. David Lippy and Abraham Nicodemus, Mansfield, O., assignors of one-third to George Moorhead, same place. Filed Nov. 7, 1904.

791,750. Trolley-Retrieving Device. Henry B. Clarke, Oak Park, Ill. Filed Sept. 3, 1904.

791,777. Car-Fender. Joseph Hastreiter and Clemens Dillhoff, Morgantown, W. Va. Filed March 18, 1905.

791,816. Current-Collecting Device for Electric Cars. Leon W. Pullen, Philadelphia, Pa., assignor to the Wireless Railway Company. Filed July 18, 1904.

791,835. Trolley. Louis M. Steele, Middletown, O. Filed Nov. 12, 1904.

791,836. Electric Train-Control System. August Sundh Yonkers, and Axel Magnuson, New York City. Filed Feb. 16, 1905.

791,972. Automatic Electric Signaling System for Railways. David C. Wolfe, Lyons, Kan. Filed Jan. 5, 1905.

791,984. Train-Controlling Mechanism. Henry V. Miller, Chicago, Ill., assignor to the Miller Signal Company, same place. Filed Jan. 14, 1905.

Electrical Machinery and Apparatus.

791,464. Electric-Motor-Controlling Device. Arthur E. Handy, Providence, R. I., assignor to the Rhode Island Elevator & Machine Company. Filed Sept. 19, 1904.

791,594. Electromagnetic Block System. Guion Thompson, Two Harbors, Minn., assignor to the Thompson Safety Appliance Company. Filed May 16, 1901.

791,673. Electric Meter. Frank P. Cox, Lynn, Mass., assignor to the General Electric Company. Filed March 2, 1903.

791,780. Electric Time-Switch. Jacob Helmstadter, Jr., McKeesport, Pa. Original application filed Dec. 11, 1903. Divided and this application filed July 26, 1904.

791,785. Direct-Reading Horse-Power and Watt Meter. Harry Hertzberg and William P. Snyder, New York City. Filed Feb. 2, 1904.

791,885-886-887. Controller for Electric Motors and Motor-Controlling System. Arthur C. Eastwood, Cleveland, O. Filed Sept. 14-16 and Oct. 24, 1904.

791,954. Time-Controlled Electric Switch. Joseph G. Swallow, New York City. Filed July 23, 1904.

Telephones and Telephone Apparatus.

791,655-656. Telephone-Current Reinforcer or Relay. Herbert E. Shreeve, Newton, Mass., assignor to the American Telephone & Telegraph Company. Filed July 8, 1904, and Feb. 28, 1905.

791,657. Telephone-Transmitter. Emil R. Snyder, New York City, assignor of one-half to Rudolf Lenk, Brooklyn, N. Y. Filed March 21, 1904.

791,892. Telephone-Transmitter. Milton J. Fletcher, San Antonio, Tex. Filed March 3, 1904.

Miscellaneous.

791,491. Facsimile-Telegraph Apparatus. Herbert R. Palmer, Cleveland, O., assignor by mesne assignments to the Electrograph Company of America. Filed Feb. 25, 1901.

791,547. Vapor Electric Apparatus. Samuel Ferguson, Schenectady, N. Y., assignor to the General Electric Company. Filed Jan. 18, 1904.

791,562. Electric Flash-Sign. John C. Lion, Philadelphia, Pa. Filed Feb. 20, 1905.

791,582. Automatic Starting Device for Vapor Apparatus. Robert E. Russell, Schenectady, N. Y., assignor to the General Electric Company. Filed March 16, 1904.

791,591. Electromagnet. August Sundh and David L Lindquist, Yonkers, N. Y. Filed Oct. 27, 1904.

791,603. Electrical Contact Device. Henri Beau, Paris, France, and Cipriano Portillo, Madrid, Spain. Filed July 10, 1902.

791,635. Electrode for Primary Batteries. Theodor Mann and Carl Goebel, Duisburg, Germany. Filed Jan. 21, 1903.

791,691. Electric Heater. William S. Hadaway, Jr., East Orange, N. J. Filed Aug. 4, 1903.

791,730. Electrical Mouth-Bath. Johan J. Stanger, Ulm, Germany. Filed June 1, 1903.

791,797. Electric Self-Winding Clock. Apollinarius von Kaspis, Weehawken, N. J. Filed June 23, 1904.

791,856. System of Electrical Distribution. Vincent G. Apple, Dayton, O. Filed Feb. 18, 1904.

791,882. Thermostat. John H. Cornelison, St. Louis, Mo. Filed Feb. 15 1905.

791,938. System of Electrical Distribution. Granville E. Palmer, Boston, Mass., assignor of one-half to Charles B. Price and Frank S. Price, same place. Filed July 5, 1904.

THE TELEPHONE WORLD.

National Interstate Telephone Convention.

The eighth annual convention of the National Interstate Telephone Association will be held at the Auditorium Hotel, Chicago, June 20, 21 and 22, at which a great assemblage of Independent telephone representatives, it is expected, will attend.

The members of the advisory board and the executive council will meet in Chicago on June 19 at 10 A.M., for the purpose of arranging all matters of detail connected with the convention, as provided for in the by-laws of the association.

The meeting will be called to order at 10 o'clock on Tuesday, June 20, and Mayor Dunne, of Chicago, will deliver the address of welcome. The response will be made by Breckenridge Jones, of the Kinloch Telephone Company, of St. Louis. An address will be delivered by James B. Hoge, of Cleveland, on "The National Interstate Telephone Association," followed by Theodore Gary, of Macon, Mo., who will speak on "Ways and Means to Make Our Association a Success." This will conclude the morning session, and the afternoon meeting will be called to order at 2:30 o'clock. This meeting will open by a roll call of States. (Each State has been requested to have some one respond for it. This member will be expected to give a talk of from three to five minutes on the telephone situation in his State).

James S. Brailey, Jr., of Toledo, O., will read a paper entitled, "Shall the Independent Telephone Companies Have an Insurance Company of Their Own?" which will be followed by "Combined Telephony and Telegraphy," by Samuel G. McMeen, of Chicago, and "What Arrangement is Necessary Between the Operators and the Manufacturers to Protect Independent Companies?" by Thomas Bromley, of Muncie, Ind.

Response to foregoing by a member of the manufacturers' committee.

The second day's session will be called to order at 10 A.M., and after a paper by L. B. Brooks, of St. Paul, on "Standard Toll Signs," reports of committees will be received. This will conclude the morning session, the afternoon session being devoted to various papers for the transaction of miscellaneous business and the election of officers.

On June 22 the entire day will be devoted to visiting and inspecting exhibits, and such entertainment as the manufacturers will tender the delegates, the whole to close with an elaborate banquet at the Auditorium in the evening. The entertainment committee has not yet announced its programme, but it is understood that it will have some jolly surprises for the delegates. This committee is composed of the following named gentlemen: P. C. Burns, H. B. McMeal, W. H. McDonough, W. E. Doolittle, G. A. Briggs, J. P. Cracraft and S. A. Dinsmore who will be in charge of the banquet., which will be an elaborate one, with all the trimmings that go to make an affair of this kind a complete sucess.

Two Kansas companies were recently organized—the Riverdale Mutual Telephone Company, capitalized at $5,000, and the Citizens' Telephone Company, of Marvin, with a capital of $1,000.

Telephone System for Long Island Railroad.

The Long Island Railroad is completing, in connection with the electrification of its western lines, a private telephone system, so that the superintendent at Long Island City can keep in touch with all parts of the road. These road telephones will be scattered about the 50 miles of line, no two being more than 2,000 feet apart. There will be about 150 of them, 100 being in special boxes similar to the police telephone boxes, and the rest in the switch towers and stations.

In connection with the telephone service the railroad will introduce a novel method of road inspection by emergency crews of four men who will constantly patrol the road in gasoline motor cars running on the tracks.

The Holland, O., Home Telephone Company, capitalized at $5,000, has been incorporated by Harry W. Lloyd, Edgar C. Hampton, John A. Belford. James R. Kerper and Harry E. Duguid. The incorporators are employes in the office of King & Tracy, who filed the incorporation papers. The purpose of the company is to build an Independent telephone line in Holland, connection with which town will be made with Toledo, through the Toledo Home Telephone Company.

The Independent Telephone Company, of Salt Lake City, Utah, has accepted the franchise as was set forth in the ordinance. It agrees to pay a sum of $100 down within 30 days of acceptance, and $100 each year after first five. It will also pay the city 40 cents annually on all the telephones installed in Amercan Fork, and will allow the city the use of two free telephones.

The directors of the Home Telephone Company, of Kansas City, Mo., have declared a quarterly dividend of 1¼ per cent., payable July 15, on the stock of the company. The officials declare that the company is earning enough to justify the payment of dividends at the rate of 5 per cent. annually. The bid price was advanced 3 points to 75. No sales were reported in Kansas City, but there was some trading in St. Louis.

News from Westfield, Mass., states that the New England Telegraph & Telephone Company has arranged to install a special line to Hampton Plains, for use at the time of the militia encampment. Two public pay stations will be on the field.

F. R. Ogg, attorney, and M. C. Miller, banker, of Olathe, Kan., recently purchased the Olathe Citizens' Telephone Company from Oscar O. Ayers, for $35,000. The company was started a few years ago and now has about 800 telephones.

The Independent Telephone Company of Emporia, Kan., has absorbed the Bell telephone exchange. The Bell Company will retain its long-distance station there.

Telephone girls of Springfield, Mo., have a union which is affiliated with the American Federation of Labor.

A switchboard will be established at Shawnee, Okla., that will serve 1,100 subscribers.

Attorney Philip Ryan, recently stated that he was prepared to appear before the Newport, O., general council in the near future and ask for rights to string wires, both above and underground, for telephone purposes. Mr. Ryan is representing Mr. Kineon and associates, and it begins to look as if the war for cheaper telephone service in Newport were on in earnest.

The Lincoln, Neb., Telephone Company elected the following corps of officers at its recent meeting: President, F. H. Woods; vice-president. A. W. Field; secretary-treasurer, W. E. Sharp. The board of directors consists of the following: C. J. Bills, Samuel Meyer, John F. Dorgan, Mark W. Woods, A. C. Ricketts, George J. Woods, A. W. Field, W. E. Sharp and F. H. Woods.

An association of telephone employes has been formed in England to protect their interest under the transfer to the Government. Some 13,000 have, it is said, joined. The chief question at present is the demand for an equitable pension scheme for all the employes.

The Citizens' Local Telephone Company, Erma, N J., has been formed to maintain telephone lines, etc. Its capital stock is $10,000, and incorporators: Edward A. Wells, H. J. Fleischhauer, John W. DeHersey, H. V. Soults and others.

A telephone system is being constructed along the line of the big irrigating canals in the vicinity of Reno, Nev., to facilitate communication regarding canal conditions between owners of land and the office at the headgates.

The Pennsylvania Telephone Company is soon to start the work of installing a new exchange board at the Pennsylvania Railroad telephone exchange at Enola.

The New York State Independent Telephone Association will hold its annual convention in the Common Council Chambers, City Hall, Albany, June 16.

At a recent meeting of the stockholders of the Laingsburg, Mich., Telephone Company, they voted to increase the capital stock from $25,000 to $100,000.

The Bremer & Black Hawk Mutual Telephone Association has been formed in Iowa with a capital of $10,000. D. G. Boomer is interested.

The Conestoga, Pa., Telephone Company is putting up poles and will install a number of 'phones in the near future.

Fifty new telephone companies will be placed on the tax list of South Dakota this year.

Telephone statistics show upwards of 300-000 rural telephones in use on Iowa farms.

The Lawn Ridge, Ill., Telephone Company has increased its capital from $3,500 to $21,000.

Telephone Incorporations.

The Western Rural Telephone Company, Harper, Mo. Capital stock, $1,600.

The Perry County Telephone Company, New Lexington, O. Capital stock, $35,000. Incorporators: John Amberge, T. W. Potter, Henry Stefen, M. E. Joyce and J. A. Wright.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Batavia, N. Y.—The Genesee County Electric Light, Power & Gas Company has been incorporated with a capital of $100,000 by Simon B. Storer, Syracuse; Raymond M. Walker, and Charles C. Bradley, of this city.

Beloit, Wis.—H. W. Eggleston and Engineer Secole contemplate erecting an electric light plant at the waterworks power house.

Benicia, Cal.—Col. William S. Patton, chief quartermaster of the Department of California, has received authorization from the War Department to install electric lights at the Benicia barracks.

Cherry Valley, N. Y.—The proposed electric lighting plant for this place embraces the building of two dams and laying of a long pipe line in addition to usual expenses of such a project. The company expects to be able not only to furnish light to Cherry Valley and Sharon Springs, but also to those living between these places who may desire it. It also hopes to be able to furnish power to a limited extent for other purposes.

Cordele, Ga.—The electric service through the business part of this city was lately damaged by fire. The loss is estimated at $50,000.

Dardanelle, Ark.—Bonds have been sold to the amount of $17,000, for the purpose of installing an electric light plant here, to be owned and operated by the town.

Lake Charles, La.—The city council has passed an ordinance calling an election June 27 for a vote as to whether or not the city shall issue bonds to the amount of $75,000 for the establishment of an electric lighting plant.

Maywood, Mo.—Residents of this place are looking to Independence for their electric lights and have made a proposition to pay the expense of wires to that locality, provided they are credited with light bills in similar amounts.

Mexico City, Mex.—The Mexican Light & Power Company, a Canadian concern operating here, has purchased all the light and power plants of this city. This is believed to be the largest individual deal in the commercial history of Mexico. The amount paid the Mexican Gas & Electric Company is $5,000,000 and to the Idlefonso Company $4,000,000 in stock and $2,000,000 in bonds are given for its properties, the total figures of the deal being $11,000,000. The expenditures of the Mexican Light & Power Company when work is completed will be $40,000,000.

Mill Shoals, Ill.—This city will soon have a system of electric lights.

Monroe, Mich.—After five years of municipal ownership of its electric lighting plant this city is talking of disposing of it. One official suggested that it be leased for 10 years, others thought it should be sold. The Detroit, Toledo & Monroe Short Line people have made a proposition to furnish light, and a committee will report to the council.

New Orleans, La.—The Consumers' Electric Light Company has secured a site for its plant and will at once begin the erection of a first-class and completely equipped building.

New York City.—The Empire State Gas & Electric Light Company, capitalized at $50,000, has been incorporated by William H. Cooper, N. Raymond Fox and Claude J. Van Slyke. —The New York Edison Company and the United Electric Light & Power Company announces that on and after July 1 the price of electric current supplied to retail customers will be 10 cents a kilowatt hour for both electric lighting and power. The new rate will not affect the bills of customers who are now, owing to high average use of installation, purchasing electric current at low prices. Unless written notice to the contrary is received, all existing contracts will be continued in force at the modified rate.

Phœnixville, Pa.—An electric light plant, to furnish light at a greatly reduced cost, is proposed for this place, Royersford and Spring City.

Reading, Pa.—The council has purchased the Charming Forge mill dam and old saw mill property, and will at once begin the erection of a suitable building for the electric light plant.

Springfield, O.—John Ryan has formed a company which will install an electric plant at Yellow Springs, for the purpose of lighting that town.

Trenton, Mich.—The electric lighting plant in this city was recently destroyed by fire, entailing a loss of $5,000.

Topeka, Kan.—There is a rumor to the effect that there is another electric light company which will shortly ask the city council for a franchise to manufacture and sell light to this city.

Warren, Tenn.—An electric light and waterworks franchise has been granted to Fred L. Purcell by the city council.

STREET RAILWAYS.

Casper, Wyo.—A movement is on foot here for the formation of a syndicate to construct an electric railroad from this city to Alcova, the site of the great Government dam of the Pathfinder, or North Platte project.

Cheyenne, Wyo.—A meeting of the Cheyenne board of trade is to be called soon to hear a proposition from Judge John Porter, of Des Moines, Ia., to build an electric car system here. Judge Porter has investigated conditions and is convinced that such an investment would pay. He proposes to put in a $100,000 system, provided Cheyenne citzens will subscribe $20,000 worth of bonds.

Council Bluffs, Ia.—The electric line survey from here has now progressed to a point seven miles northeast of Treynor.

Denver, Col.—C. P. Bolmar, of Topeka, Kan., an officer of the Railway Supplies Company, is forming a company for the purpose of building an electric line from the lakes to this city by way of Kansas City.

Dubuque, Ia.—An electric road is to be built from this city to Platteville, Wis.

Elm Grove, W. Va.—Surveys for a new trolley line between here and Mozart Park have been made.

Galesburg, Ill.—The new trolley company which has acquired the defunct lines of the old Monmouth & Galesburg Company, will at once build a system connecting Monmouth and this city.

Jersey City, N. J.—The Jersey City street and water board has passed a resolution directing the trolley, telephone and telegraph companies to place all their wires underground within one year after Mayor Fagan shall approve the resolution. The board also ordered that all poles and rails shall be removed from streets where cars are not run.

Los Angeles, Cal.—The Los Angeles-Pacific Company proposes to extend its electric line to Irwin Heights.

New Brunswick, N. J.—If the present intention of building a trolley line from Freehold to Asbury Park is carried out there will be a continuous trolley line from this city to Asbury Park, and from New York to Asbury Park through this city.

Newburgh, N. Y.—The Upper Hudson Electric & Railway Company has been formed to operate an electric road. Its capital stock is $500,000, and incorporators, Luke F. Gillespie, J. N. Sheehan, Eugene Wolfe, N. W. Titus, T. M. Sheehan, N. W. Dalton and F. J. Curnick.

Norfolk, Va.—A new electric trolley line will be built through Norfolk County, connecting Ocean View and Pine Beach. A syndicate composed of local people has been quietly at work for some time securing rights of way for the new road, and it is proposed to begin construction so that the line can be in operation before the close of the summer season. There is $300,000 capital behind the new road, and it is announced that J. W. Perry, of this city, is interested.

Peoria, Ill.—The Central Railway Company has increased its capital from $1,050,000 to $1,260,000. Its object has been changed to operate an electric railway in the city and county of Peoria, and the counties of Tazewell, Woodford, Marshall, Stark, Knox, Fulton, Mason and Logan,

South Bend, Ind.—The South Bend Western Railway Company, incorporated with a capital of $100,000, will build an electric line from Laporte to this city, 28 miles, and from New Carlisle to Michigan City, 16 miles.

POWER PLANTS.

Chattanooga, Tenn.—The Chattanooga & Tennessee River Power Company of Hamilton County, with a capital stock of $3,000,000, has been incorporated by C. E. James, Josephus C. Guild, R. H. Williams, Morris Headrick and James C. Sims. The developing of the water power in Hamilton and Marion Counties, and the manufacturing and distributing of electricity is the purpose for which the company is formed.

New Castle, Pa.—The Western Pennsylvania Power Company is getting ready to commence operations in this part of the country. The company, which is composed of Pittsburgers, has a capital stock of $10,000.

BIDS WANTED.

Washington, D. C.—The Navy Department through the Bureau of Supplies and Accounts is inviting sealed proposals until June 27 for furnishing Eastern Navy Yards with the following electrical supplies: Schedule 301, motors, generating sets; schedule 302, generators; schedule 303, incandescent lamps, wire, rheostats, mica, miscellaneous electrical supplies. Blank proposals and full schedules can be obtained upon application to the Bureau or to the Navy Pay Office in New York.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅛@15¼c.; Lake 15⅛@15¼c.; casting, 14⅞@15c.

The United Traction & Electric Company of New Jersey has declared a dividend of 1¼ per cent., payable July 1.

The Federal Telephone Company of Cleveland, O., will soon be dissolved. The company owes about $3,000,000.

Philadelphia Union Traction Company directors have declared a semi-annual dividend of $1 a share, payable July 1.

The New England Telephone & Telegraph Company will require for new construction work during the year, it is estimated, $4,750,000.

The General Electric Company has declared the regular quarterly dividend of 2 per cent., payable July 15 to shareholders of record June 19.

The regular quarterly dividend of 1¾ per cent. on the stock of the Manhattan Railway Company of New York will be paid July 16. Books close June 28 and reopen July 10.

Judge Halsey, of the Circuit Court, Milwaukee, Wis., has appointed John E. Reilly receiver of the Independent Consolidated Telephone Company of that city under a bond of $30,000.

The Interborough Rapid Transit Company of New York has declared a quarterly dividend of 2 per cent., an increase of ¼ per cent. over the previous payment, payable at the office of August Belmont & Co., July 3.

The deficit of the Metropolitan Street Railway Company of New York in nine months is $1,322,405, suggesting $1,900,000 for the year. This discrepancy between earnings and the guaranteed 7 per cent. dividends the Metropolitan Securities Company must make good.

The 2,000 additional shares of stock of the United Electric Light Company of Springfield, Mass., to be issued at $160 a share, is offered stockholders in the ratio of one new share for each four now held. Subscriptions close June 24, payment in full being called for on July 3.

According to a recent statement issued by F. R. Henry, auditor of the United Railways Company of St. Louis, the gross earnings of the corporation for the month of May were $756,357, as against $841,006 for the month of May last year, during the World's Fair. The gross earnings for May, 1903, were $644,457.

Fisk & Robinson of New York have recently purchased all the bonds and stock of the Kansas City-Leavenworth Electric Railway Company. The name of the corporation will be changed to the Kansas City-Western Railway Company. The bonded debt will consist of $1,500,000 out of an authorized issue of $5,000,000 twenty-year 5 per cent. gold bonds. Capital stock, $2,500,000.

After fighting each other for more than thirty years, it was announced on Saturday that the two largest companies manufacturing steam and electric drills have formed a corporation to be known as the Ingersoll-Rand Company. The two companies were the Ingersoll-Sergeant Company and the Rand Drill Company. They have been incorporated under the laws of New Jersey at Trenton with a capital stock of $10,000,000, $5,000,000 of which is preferred stock and an equal amount of common. W. L. Saunders, formerly president of the Ingersoll Company, was elected president.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. **Name.**	Closing price June 10
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	204⅛
Manhattan Elevated Railway	164
Metropolitan Street Railway	123
Metropolitan Securities	79½
Ninth Avenue	197
Third Avenue	126
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	64⅞
Brooklyn City Railway	240
New Orleans Railway	..
Public Service Corporation (New Jersey)	121
Philadelphia.	
Consolidated Traction of New Jersey	83¼
Philadelphia Traction	99½
Union Traction	62¾
Boston.	
Boston Elevated	157
Massachusetts Electric Companies, com	16½
do. do. do. pref.	66
West End Street, com	96¾
do. do. do. pref.	116½
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	6⅝
do. do. pref.	45
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	14¼
do. pref.	52⅛
Electric Boat, com	37
do. do. pref.	75
Electric Lead Reduction	¼
Electric Vehicle, com	17
do. do. pref.	21
Westinghouse, com	166
do. pref.	190
General Electric	174
Boston.	
Edison Electric Illuminating	245
General Electric	174
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	155
National Carbon, com	62¼
do. do. pref.	116
Philadelphia.	
Electric Company of America	11⅜
Electric Storage Battery, com	76⅛
do. do. do. pref.	76⅞
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	140⅛
Western Telephone Company	18
New England Telephone Company	138⅛
New York.	
American Telegraph & Cable Company	95
Commercial Cable Company	210¼
Mexican Telephone Company	1⅛
New York & New Jersey Telephone Company	172⅛
Postal Telegraph Cable Company	..
Western Union Telegraph Company	94
Chicago Telephone Company	133
MISCELLANEOUS STOCKS.	
Otis Elevator Company	52
Consolidated Car Heating	64
Standard Underground Cable	200

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130
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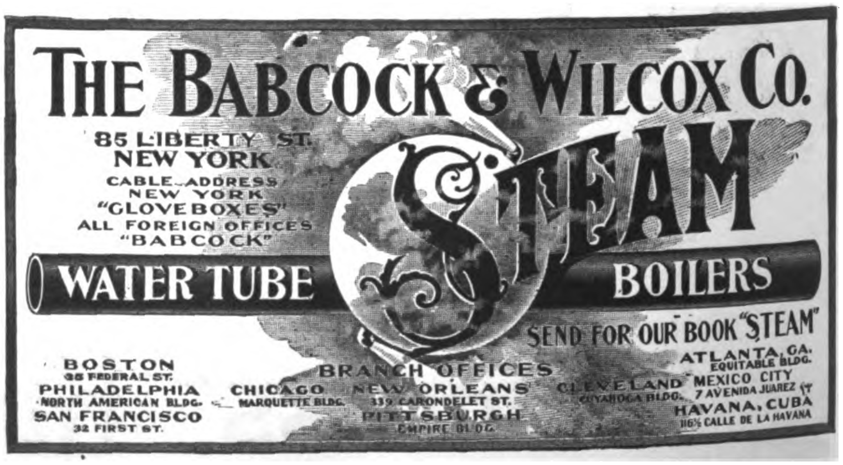

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EDITORIAL NOTES.

The Builders' Debt to Electricity.

There are few problems in daily life which attract as much attention as those relating to our own personal comforts. In the home, these comforts in a sense, must be provided. In business circles they have not been enjoyed until recently. The building trades have given an immense impetus through the advent of electricity. The rise in real estate values, the greater value of the buildings constructed for business purposes, and the advantages at present in the transaction of all business, reflects great honor upon the initiators of the original movement in this direction. All fields of conservative work are affected but slowly by innovations. The first tall buildings in New York are now dwarfed into insignificence in comparison with those which came later, yet it was considered a risk and a sensation to attempt to break away from the old traditions. England still sticks to them to-day and the traveler in that staid old country sees nothing but low structures in the very heart of the busiest part of London. Tall buildings in New York, which supply the means of comfort to thousands of office workers, could never have come into existence, nor developed into what threatens to be a fixed natural institution, if it were not for influences which gave rise to them. These influences were primarily dependent upon the enormous values, as they were then considered, asked for small pieces of ground. They were secondarily, the combined advantages arising from the use of steel frames and the introduction of electricity for a host of purposes. Of course the manufacturer of typewriters claims the throne of honor as the business benefactor of mankind. Then follows the telephone company. After these come the elevator concern, the electric light and power company, the electric lamp, annunciator, bell and telegraph company, etc., until the list stretches out to the very sticks and stones of which the building is composed. This is not the attitude, however, which leads to a serious estimate of the greatest influence at work in promoting, on the one hand, the great apartment houses, apartment hotels, and hotels proper; and on the other hand, the remarkable palaces of business, erected in the downtown or commercial districts of every large American city, particularly New York and Chicago.

There are few who would deny that if the choice were to be made by a home-seeker between an apartment house without telephones and electric lights and one supplied with all these accessories that, for equal rents or even slightly higher demands, there would be any hesitation in choosing the more modern place.

This is the keynote to the situation. The idea of modernness is associated with the improvements the present age has supplied. Not only must the home at present possess these essentials to a greater or less degree, but the office building without them would be on its face a failure. The builder and the architect have long recognized these facts and they now co-operate with the steam expert, the elevator builder and the electrical expert in supplying just as much and, if possible, a little more than their competitors in the same field. The swiftly moving elevator in our tallest office buildings, called in many instances an express, is dependent upon electric power for the facility with which it performs its work. The lighting problem of all fine office buildings is emphatically an electric one. The ventilation in many cases belongs to the same category, while the telephone, ticker and signaling devices in the Wall Street district are matters of course. The builder's debt to electricity is as great in some respects as his obligation to those who supply him with the masonry and steel for the gigantic monoliths his ingenuity successfully constructs.

* * *

The Mysteries of the Boiler Room. The boiler room of electric light plants holds a place second to none in the field of applied science. The boiler room, or more properly speaking the boilers, call for the most careful consideration in the estimate of the efficiency to be expected or obtained. The reason for this is in some respects obvious. A boiler is a steam producer. The production of steam is in strict proportion to the absorption of heat. The amount of heat produced by the consumption of coal has nothing to do with the steam production unless the two are forcibly made to stand in a strict relationship to each other. The engineer speaks of the fuel consumption per horse power hour. The electrical expert establishes a ratio between the horse power of the dynamo and that of the engine driving it. And in this manner the problem arranges itself in the minds of both. The boiler and engine to one, the engine and dynamo to the other. If the term efficiency is applied, then the mother of it all, in this chain of devices, must receive first consideration. The boiler is the center of gravity of the system, and if its design does not permit of a high efficiency, then the ineffectiveness of the rest becomes doubly apparent. The furnace of a boiler, its grate bar surface, the character of the draught and of the fuel are considerations which outweigh all else in the plant. If loss occurs here, with seeming neglect, then all the valuable and efficient devices which follow are in a sense wasted.

The remarkable science and skill brought to bear upon the engine, in order to make it yield its proper quota of efficiency, the splendid investigations which led to the successful construction of high grade and durable dynamos, seem like the practice of economy at one end of the system and reckless extravagance at the other. The boiler room contains many mysteries therefore to those who struggle in vain with plants that possess the perverse spirit of a persistently low economy.

The mysteries spoken of only exist through the ignorance of those entrusted with the care of important plants. A good set of boilers is a surer guarantee of financial success in the operation of an electric plant than perhaps any other element of it. Electrical engineers particularly are more apt to concentrate their energies upon the engines and dynamos than upon the boiler plant. As much ripe, up-to-date information is required here as elsewhere. A fuller knowledge will wipe out these discrepancies and remove the so-called mysteries.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The meeting of the American Institute of Electrical Engineers is now in session at Asheville, N. C. Friday will be closing day.

◆

The Western Electrical Inspectors' Association was lately formed in Chicago there being 60 cities of the middle West represented at the charter meeting. F. D. Varnum, electrical inspector of St. Paul, was elected president of the association.

◆

Mr. James Dalrymple, the Glasgow expert, who has been giving pointers to Mayor Dunne of Chicago, says municipal ownership of street railways will not succeed in the United States unless absolutely divorced from politics.

◆

The Magnetic Club of New York will hold its summer meeting at College Point, L. I., June 27.

◆

The entrance examinations for the Massachusetts Institute of Technology will be held at the Rogers Building, Boston, Wednesday, Thursday, Friday and Saturday, June 28 to July 1. A second series of examinations will be held on September 19, 20 and 21. Applicants for advanced standing must pass the June or September examinations, and must present themselves for further advanced examinations in September.

◆

Mr. Nikola Tesla has written another letter about New York's Subway, and this time he predicts a mine horror unless the formation of explosive gas is not halted at once. Mr. Tesla's statement is as follows: "It is to be regretted that this important pioneering enterprise should have been treated with such gross neglect in its most important feature. No opportunity was given me, the inventor and patentee of the system in the Subway, to offer any suggestions. The danger to which I refer lies in the possibility of generating an explosive mixture by electrolytic decomposition and thermic dissociation of the water through the direct currents used in the operation of the cars. Such a process might go on for hours and days without being noticed, and with currents of this kind it is scarcely practicable to avoid it altogether. What the effect of such an explosion would be on life and property is not pleasant to contemplate. True, such a disaster is not probable, but the present electrical equipment makes it possible and this possibility should by all means be removed. The oppressiveness in the tunnel is due in a large measure to the heat supplied by the currents. Some provision for ventilation is imperative, but ventilation will not do away with the danger I have pointed out. It can only be completely avoided by discarding the direct current." Mr. Tesla's statement, it is said, was pooh-poohed at the office of L. B. Stillwell, the chief electrical engineer of the Subway system. Mr. Stillwell refused to commit himself further than to challenge the inventor to make good his charges before the Institute of American Electrical Engineers.

◆

Secretary Foster informs us that the date for the meeting at Erie, Pa., of the International Association of Municipal Electricians has been changed to August 23, 24 and 25.

◆

On June 29-30 at Portland, Ore., in connection with the exposition, will be held simultaneously the Pacific Coast Engineering Congress and the Transmission Convention.

◆

The 15th annual convention of the Canadian Electrical Association assembles at Montreal to-day and will adjourn on Friday. To-day the convention will listen to reports, and papers will be read by Messrs. M. A. Sammett, R. T. McKeen, William Bradshaw and A. B. Lambe. Thursday papers will be read by Messrs. A. L. Mudge, H. A. Burson and Prof R. B. Owens. In the afternoon the delegates will enjoy a special visit and luncheon at the Allis-Chalmers-Bullock Company's factory at Rockfield. On Friday papers will be read by Messrs. K. L. Aitken and William McKay, to be followed by the Question Box and election of officers.

◆

The convention of the National Electrical Trades' Association will be held in Montreal, Canada, beginning June 23. John Foreman, of Montreal, is president of the association.

◆

Under the personal supervision of Superintendent of Motive Power Gibbs, the Pennsylvania Railroad Company is having built the largest electric motor in use anywhere. It will be employed to draw the trains through the North River tunnel. As the tunnel grades will be heavy a powerful motor will be needed. It will follow the general pattern of the motors in use in the Baltimore & Ohio tunnels in Baltimore. It will also be used in the East River tunnel in New York if found serviceable. The new machine will not be completed in less than four months. It will be 38 feet long and will exceed 150 tons in weight. This is considerably more than the weight of any passenger locomotive.

◆

Preparation is being made to lay the third cable to reach from Galveston, Tex., to Coatzacoalcos, Mex., a distance of about 900 miles.

◆

Electric fans are used in the chair cars of the Rock Island Railroad.

◆

THE TANTALUM INCANDESCENT LAMP.*

BY DR. LOUIS BELL.

The writer was lucky enough to receive through the courtesy of Mr. E. D. Adams ten 25 Hefner 110-volt Tantalum lamps. These were, with the kind assistance of Prof. Puffer, put through various tests, and in particular two of them were given a decay test with the rather startling results recently published in a joint paper. The upshot of the matter was that these two lamps, selected as being about the average of the lot in performance, gave a life of some 850 hours before falling below 80 per cent. of their initial candle power, and were both burning at 16.6 cp. at the end of 1,190 hours, although one of them had at some unknown time in the previous three days run broken a filament close to one of the spider arms and had automatically mended itself by the fall of the loose end across the other side of the same loop where it welded itself firmly into place and went on burning.

These two lamps ran 800 hours of their life at a mean horizontal candle power of 20 and at about 2.05 watts per candle, thus giving 16,000 candle hours of useful life at this extremely high efficiency. On a rating of 2 watts per candle average the lamps were good for 600 hours, giving over 12,000 candle hours. On a rating of 1,000 hours they gave nearly 19,000 candle hours at a mean energy consumption of, say, 2.15 watts per mean horizontal candle. The circuit on which the run was made was on the average fully up to the rated 110 volts, although the pressure varied somewhat irregularly, perhaps a couple of volts on each side of this figure.

The light of the Tantalum lamp is, as might be expected from its high efficiency, rather whiter than that of an ordinary incandescent, being as white as the Nernst lamp or the acetylene flame. Its distribution of light is in the present form of filament rather less uniform than that of the common incandescent, being relatively more powerful in a horizontal zone and less powerful for points near the axis. The ratio of mean spherical to mean horizontal candle power, as found in Prof. Kennelly's investigation of the frosted lamps, proved to be .73 and the writer's figure from the clear lamps was substantially the same. The distribution, however, could very easily be improved so that the spherical reduction factor would not differ materially from the usual figures and the light at the top would be correspondingly increased.

Since the Tantalum filament has a low initial resistance (between 55 and 60 ohms) it jumps into incandescence with startling rapidity as compared with a carbon filament, but because of its positive temperature coefficient it seems to be decidedly less sensitive to changes of voltage in its working condition. This is a useful property in certain respects. The fact, however, that the initial resistance of the Tantalum is so low and its thermal inertia so small owing to its small mass and low specific heat, means rather violent heating up, which is probably the cause of some doubts which have been expressed as to the endurance of these lamps upon alternating circuits. It is not difficult to imagine pretty severe strains upon the filament if it had time to cool down much between impulses. If such cooling could take place for instance on an ordinary alternating circuit, the results might be serious.

Some stroboscopic tests were therefore made at the last moment to determine whether at, say, 25 there was a specially violent fluctuation of light from the Tantalum lamp; in other words, to find out whether on a 25 current the filament had time to cool down materially. The result showed that the light fluctuation at this frequency was somewhat but not much more pronounced than in a carbon filament. The Tantalum lamp behaved in fact about like a 10 cp. carbon filament lamp. Even a 75 cp. carbon filament lamp, however, shows perceptible variation under this test. At 60 cp. the fluctuation while still perceptible was trivial both in the Tantalum and carbon lamps. It hardly seems probable that at 60 cp. the life of the Tantalum should be enough impaired to cause serious trouble, but the writer now has some lamps on alternating current tests and proposes to pursue the inquiry.

The Tantalum filament seems to stretch and sag at first as if undergoing annealing and losing the set produced by drawing. Then it shows local bright spots which grow lumpy as if the material tended to flow a little from the heat, and with the increasing lumpiness the filament draws up tight. At this stage it is rather fragile and would probably break easily from vibration or shock. It seems likely that the final break comes just where one of the lumps has reduced the cross-section of the wire beside it. The break in the lamp during test, already referred to, showed considerable attenuation of the loose end.

The lamps as tested showed the following characteristics:

Lamp.	Watts.	C.P.	Watts per candle.
Clear Globes..................	41.58	21.42	1.94
	38.61	20.90	1.84
	41.58	24.93	1.66
	41.58	21.55	1.93
	41.91	21.81	1.92
	41.91	22.59	1.85
Frosted Globes................	40.36	19.79	2.03
	40.34	18.54	2.15
	40.04	18.74	2.13
	40.48	19.27	2.09

The mean result from the clear globes was 22.2 cp at 1.85 watts per candle power, and that from the frosted globes 19.08 cp. at 2.1 watts per candle power.

It is interesting to note that the clear lamp gives just about 1 cp. per inch of incandescent filament, which implies an intrinsic brilliancy of somewhere about 500 cp. per square inch of filament—a figure much higher than in the ordinary incandescent.

As illuminants the lamps are certainly very excellent, but their introduction raises some most interesting questions for the central station operator.

Putting aside all the petty questions that will be raised about the new lamps for commercial reasons, the broad fact remains that we are here dealing with a bona fide 2-watt lamp having a life fairly comparable with the carbon filament lamps now customarily in use. Moreover, it is a competitor of these socket by socket, and not as a substitute with particular requirements as in the case of the Nernst lamp or the very small arcs. There is some doubt as to the life of the Tantalum lamp when exposed to unusual vibration, which may perhaps bar it in some special locations, but for the everyday work of the central station there is good reason to believe it generally applicable.

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*Paper read before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11, 1905.

Its price can hardly be said to be fixed in this country, but abroad in Berlin it is about $1, which will give at least a fair line on its commercial results. On this basis and with current at 10 cents per kilowatt hour, one finds taking the new lamps on its 600 hour rating, that the cost of its 12,000 candle hours including the lamp amounts to $3.40. The same number of candle hours from a lamp giving a mean efficiency of 3.25 watts per candle would cost $3.90, exclusive of lamps, i. e., the consumer could afford to pay $1 for the new lamp better than to take the old ones free. With current as low as 5 cents per kilowatt hour, the user of Tantalum lamps could only afford to pay 75 cents per lamp as against getting carbon lamps free. That means that a sliding scale of discounts for lamps according to quantity could be made to catch the consumer at all prices ordinarily charged for current by central stations. Does this mean that the carbon lamp will shortly be down and out? Probably not, for there is no spur like competition to start up improvements, and there are some signs that carbon lamps may be improved enough in efficiency to make things interesting at least with current at the prices charged to very large consumers. This, however, remains to be seen, and the thing which the central man has to meet is the immediate probability of consumers putting upon their circuits lamps taking less than two-thirds the energy per candle power of the best lamps now in use and thereby cutting down their meter bills enormously. Now, broadly, what shall be the attitude of the central station man toward this income—scalping innovation? There are some managers who may be inclined to put up a fight to discourage the user, either by raising pettifogging objections or by trying to discriminate against 2 watt lamps by readjusting discounts in various ingenious ways. The writer is very strongly of the opinion that such a policy is wrong and will certainly lead to ultimate disaster in the form of municipal restrictions or regulations of rates by law. In the long run, opposition to improvements does not pay. If, on the other hand, the central station man hangs quietly on and gives the consumer the glad hand, the change will work to his ultimate benefit. In the first place the Tantalum lamps now made are of 22 cp. instead of 16 and the filament will hardly bear much reduction in cross-section. The tendency therefore will be to use these slightly more powerful lamps taking, say, 42 watts instead of a trifle over 50 watts in the 16 cp. carbon lamps. The actual loss in energy sold is likely therefore to be for the present quite a little less than the difference of efficiency would indicate.

Besides this the attraction of cheaper light will certainly bring into line new consumers so that the net result will probably be an actual increase in sales of current, quite a little of it being along the smaller consumers who pay the higher rates. Such a change means upon the whole more lights connected per unit of capacity in transformers or feeders, and hence a slightly better utilization of material and improved load. In the case of stations with underground service, the change to 2 watt lamps ought to bring with it increased earnings per unit of cable capacity. The fact is that improvements in the efficiency of utilization of electric energy help the business and it is both fruitless and inadvisable to oppose them for any short-sighted notion of small temporary savings.

I have here said nothing regarding the inevitable competition between present lamps and the newcomer. In the first place, the merits of the final issue remain to be determined and in the second place competition in lamps is on the whole a good thing for the user of them, however it turns out. So far as the central station is concerned, it is a case of dog eat dog.

The really important thing is that from now on the station manager will have to deal directly with the 2-watt lamp proposition, for there is no disguising the fact that it is here, and in a form that is quite unexpected. The appearance of Tantalum lamps in quantity may be a little delayed in this country, but delay will improve them as in the case of every new product, and will serve to assure a better understanding of their truly remarkable properties and of their possible limitations. The unexpected has certainly happened, for most engineers had long ago abandoned the idea of a lamp with a metallic filament. Only the discovery of a metal virtually new, and possessed of the most sensational qualities, could have brought about the present striking result.

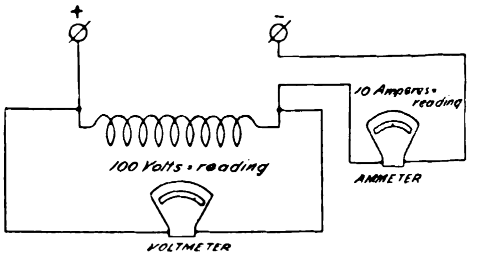
ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

ELECTRICAL MEASUREMENTS.

Measurement of Resistance.—One of the most familiar of all tests is that carried on for the purpose of ascertaining the resistance of a conductor. Though it would seem as though this included the general scope of all tests of this character, yet other tests of equal importance in an engineering sense must be made of the very opposite of good conductors, namely, insulators. Thus, tests of resistance might be generally classified as measurements of very low resistances, very high resistances and of resistances which occupy a middle place between these two. To illustrate—resistances of .01 of an ohm, of 1,000 ohms and of 1,000,000 ohms, represent a great difference in value. To make sufficiently accurate tests of these, to give satisfactory results, methods must be employed which belong to the general category of resistance measurements. A few of these tests can be considered under the heads of first, Drop of Potential Method; second, Method of Substitution; third, the Wheatstone Bridge Method.

Drop of Potential Method.—There is no reason to believe that a simpler method than this can be presented in developing the idea of resistance measurements. It is based upon the proposition contained in one form of Ohm's law that the pressure which is necessary in a circuit, to send a given current through a given resistance, is equal to the product of this current by the resistance. In other words, if the proposition is given—find the resistance of a circuit whose lost pressure or "drop" equals 100 volts when carrying a current of 10 amperes; the answer can be readily given on the above basis. A loss of 100 volts, or whatever it may be, is caused by a certain current passing through a definite resistance. The problem in arithmetic form then becomes, 100 = 10 times what value? It is quite evident that the value to be found is 10. The drop in pressure between the ends of the circuit being 100, and the current being 10 amperes, the resistance must



Getting the Resistance of a circuit by voltmeter and ammeter.

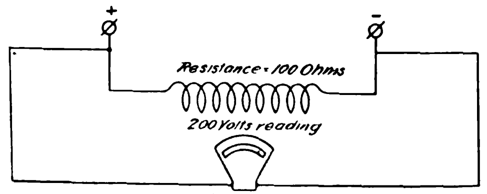
be 10 ohms. The drop of potential method therefore consists in a measurement with the voltmeter of the drop of pressure between the ends of a circuit through which current is passing. The next step, is the measurement of the current itself with an ammeter. Dividing the volts by the amperes will give the ohms as indicated. The test may be made in other ways, which merely represent modifications of this idea without any real change in the method. For instance, if the resistance of the circuit *is known*, it is a simple matter to find the number of amperes passing by ascertaining the drop in exactly the same manner. The drop in volts divided by the ohms will give the amperes. On the other hand, the idea may be still further developed for the purpose of discovering the volts consumed by the circuit. In this case the resistance, which is known, is multiplied by the current which is measured. The product will give the volts lost or "drop" of the circuit. The general idea thus presented covers a means of obtaining the resistance if the amperes and volts are known; the volts, if the amperes and ohms are known; and finally the amperes, if the volts and ohms are known. It is legitimate to include all of these tests under the one general category. Examples crystallizing the application of these methods are given in the following:

DROP OF POTENTIAL METHOD.

To get ohms.......	Measure the drop and measure the amperes.	Divide E by C.
To get amperes....	Measure the drop and know the ohms.....	Divide E by R.
To get volts.......	Measure the amperes and know the ohms..	Multiply C by R.

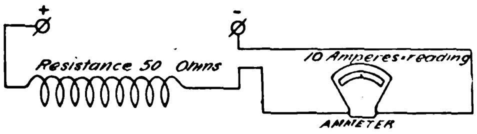
This system shows how a voltmeter is used for measuring amperes when the resistance is known. It shows how to measure volts with an ammeter when the resistance is known and, finally, it shows how to calculate the resistance of a circuit if its drop is measured with a voltmeter, and its current with an ammeter.

Examples of the Drop Method.—A voltmeter shows a drop of 200 volts between the terminals of a circuit carrying a certain current. The resistance is known to be 100 ohms, what is the current in the circuit. Dividing 200 by 100 gives a current of 2 amperes. An ammeter shows a current of 10 amperes in a circuit having a resistance of 50 ohms, what is the pressure or "drop"? Multiplying 10 by 50 gives a voltage of 500.



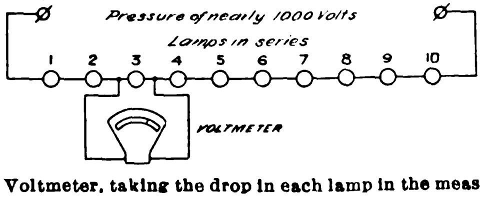
Getting the Amperes of a circuit by a voltmeter, knowing the resistance of the circuit.

How many ohms resistance has an incandescent lamp hot, whose terminal pressure is 120 volts, which takes a current of .4 of an ampere. Dividing 120 by .4 gives a resistance of 300 ohms. It is possible to use an ammeter as a voltmeter or a voltmeter as an ammeter by securing a definite length of copper wire of sufficient size to cause a slight drop when the current passes and yet not dissipate too much energy. For instance, 1,000 feet of No. 10 B. & S. would equal 1 ohm or 500 feet of No. 13, etc. If a piece of wire is obtained whose resistance is known then this placed in series with a motor, the voltmeter giving the drop across its terminals, will be the means of measuring the current. If the voltmeter reads 2 volts, and the resistance of the wire is .1 of an ohm, then 2 divided by .1 equals 20 amperes: If instead of a voltmeter an ammeter is used the test for volts can be made but the resistance must be greatly increased and must be disconnected from the motor if accurate measurement of the pressure is to be made. If the line pressure is 220 volts, it may be sent through a resistance of 100 ohms and the current of an ammeter in series will complete the test. Under these conditions 2.2 amperes would be indicated, the product of this current and 100 ohms giving the line pressure, 220 volts.



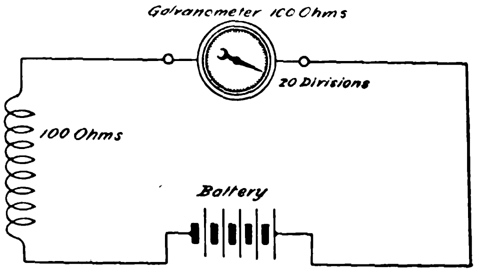
Getting the Volts of a circuit by an ammeter, knowing the resistance of the circuit.

Measuring High Pressures.—If this principle is applied to the measurement of pressures like 1,000, 5,000 or 10,000 volts the following plan is practicable: Either 10, 50 or 100 lamps are connected in series. If about 1,000 volts are to be measured about 10 lamps will do. The total pressure is then sent into this series as shown. A voltmeter is used for the purpose of taking the drop between the terminals of every lamp. The total is found when all results are added together. For instance, if the voltmeter indicated as follows: First lamp, 90 volts; second lamp, 95 volts, third lamp, 100 volts; fourth lamp, 110 volts; fifth lamp, 105 volts; sixth lamp, 98 volts; 7th lamp, 99 volts, 8th lamp, 102 volts; ninth lamp, 85 volts; tenth lamp, 87 volts; then the total equals the sum of 90 + 95 + 100 + 110 + 105 + 98 + 99 + 102 + 85 + 87 volts or 971 in all. An early method of measuring the high pressures of alternating currents before high reading voltmeters were made is thus shown. A resistance measurement by the "drop" method is therefore merely one phase of a practice covering the measurement of pressure and current as well.



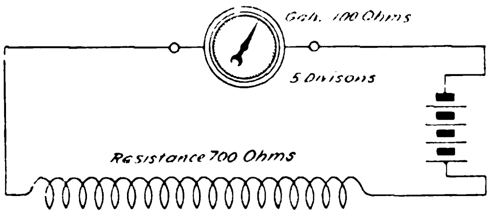
Voltmeter, taking the drop in each lamp in the measurement of high pressures.

Method of Substitution.—Measuring resistance by the method of substitution is really a comparative method. If a certain known resistance will cause an indicating instrument to show a deflection of 100 divisions; and then, when another resistance is put in its place, the deflection falls to one-half or 50 divisions, it is evident that the resistance must be twice as great. The reason for this, is found in the reduced deflection. This means less current or more resistance. If the conditions are otherwise the same, the drop in the reading of the indicating instrument to one-half proves the presence of twice the resistance. Ohm's law, as stated, that the current is directly proportional to the electromotive force, and inversely proportional to the resistance means, when applied to this case, that if the electromotive force has not changed, but the current is one-half as shown by the deflection, the resistance is twice as great. To illustrate this idea, a galvanometer must be connected to a cell of battery and a known resistance of say 100 ohms. If under these conditions, the galvanometer gives a reading of 20 divisions, the record will read, 100 ohms 20 divisions. If the 100 ohms is removed, and an unknown resistance, such as a lamp is put in its place, suppose the galvanometer now shows a deflection of only 5 divisions. The conclusions to be

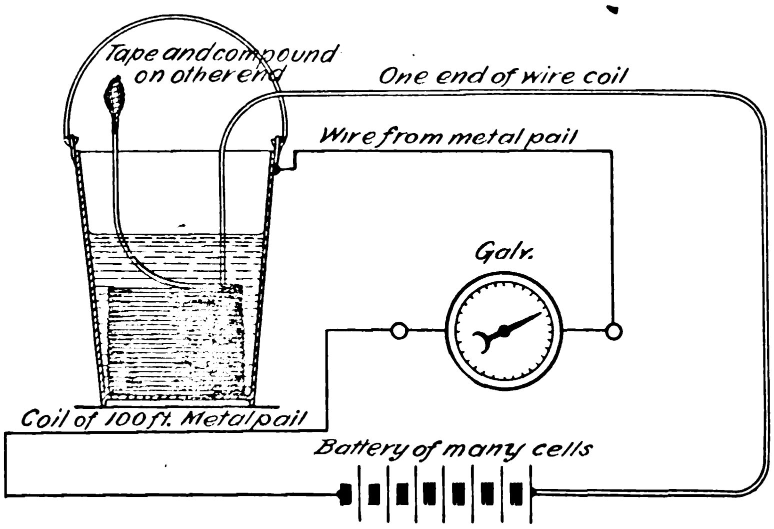


Galvanometer and resistance cause a deflection of 20 divisions.

drawn are as follows: If 100 ohms gives a reading of 20 divisions and an unknown resistance gives a reading of 5 divisions, then the unknown resistance must be greater. Its resistance is so much greater that it reduces the current down from that value, which gives a 20 division reading, to a value so much less that only a 5 division reading is possible. If the galvanometer readings are greater or less, in strict proportion to the current passing through it, then a 20 division reading and a 5 division reading fully express this idea. The reading has been reduced in the galvanometer from 20 to 5 divisions because the current passing through it has been reduced. The reduction is due to the new unknown resistance substituted for the known resistance. If the reading was cut down 20 to 5, the current must have been cut down in like proportion. Its reduction to $\frac{1}{4}$ of its original value is due to the fact that the resistance must be four times as great. If the resistance in the first case was known and valued at 100 ohms; in the second case the diminished reading to 5 divisions shows the presence of a resistance, which in conjunction with that of the galvanometer must equal four times the original. If the galvanometer $= 100$ ohms, then the proposition shows that $100 + 100 = 200$ ohms, causes a deflection of 20 divisions. It also shows that $100 +$ an unknown resistance gives a deflection of 5 divisions. The question that naturally arises is "What is the unknown resistance?" As previously stated, it must have taken four times the resistance to reduce the reading from 20 to 5 divisions. This being the case, the 200 ohms in the first instance must have been increased to 800 by the addition of the unknown resistance. If the galvanometer resistance, however, is 100 ohms, then the unknown resistance must be equal to 700 ohms. Thus, the method of substitution as outlined, calls for a knowledge of the resistance of the galvanometer, or indicating instrument. It also calls for a knowledge of the value of the first resistance interposed. With these facts known, it is evident that any reasonable resistance may be substituted for the first, and if the deflection is taken, its resistance readily calculated.

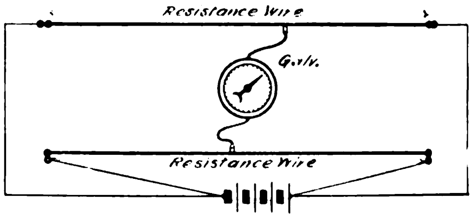


Galvanometer and a substituted resistance cause a deflection of 5 divisions.



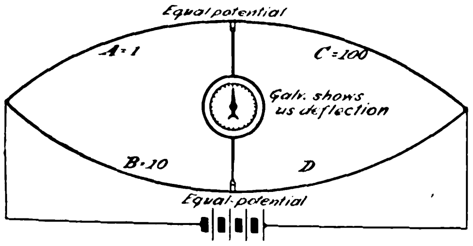
Measuring insulation resistance of rubber-covered wire.

Measuring the Resistance of Insulation.—Insulation has resistance, though it is enormous compared with conductors. An insulator so-called, is not an absolute non-conductor, but a very poor one. The idea is relative. A pressure of 1,000 volts, applied to a resistance of 1,000 ohms would mean a current of 1 ampere. A pressure of 1,000 volts applied to a resistance of 1,000,000 ohms, would mean a current of $\frac{1}{1000}$ of an ampere. If the pressure is lower, the current is correspondingly less. A telegraph line is supported on insulators. Though made of glass, these insulators permit current to leak from the line to the ground. Not one alone is responsible for the entire leakage, but the sum total. An infinitesimal current from one, multiplied by the number of insulating supports, would give the total current. If in the above case, the one thousandth of an ampere was multiplied by 10,000, the total would equal 10 amperes. This is not entirely an imaginary case for the reason that 10,000 insulators, at the rate of 25 to the mile, would only equal 400 miles between stations. The leakage per insulator might be less than that stated, but whatever it was, it would be multiplied by 10,000 on a 400 mile line. Not only is it necessary to know the relative merits of insulators for line service in order that line leakage may be reduced to its lowest value for telegraphic and other lines, but the insulation of power-carrying wires must be known as well. The following is an outline of the method of measuring insulation resistance, by the principle of the substitution of one resistance for another: The requirements are a metal pail, a sensitive high resistance galvanometer, and a carefully tested high resistance. With these, the value of the resistance of high grade insulation, reaching into the millions of ohms, can be found. The insulator, or insulated wire, is so placed in the water that the current passes through from the metal pail into the conducting solution into the insulation, and then out via the wire. If a coil of insulated wire is tested, consisting of say 100 feet of rubber covered wire, then one end of the wire is carefully coated with tape and an insulating compound. The other end leads out, also a separate wire connected to the metal pail. The coil is laid in the pail and covered with water slightly tinctured with sulphuric acid to lower the resistance of the water. The preliminary test is then made with a resistance of 10,000 ohms, which will cause a deflection of 50 divisions in the galvanometer. Supposing the galvanometer to possess a resistance of 10,000 ohms, the first galvanometer deflection is due to 20,000 ohms in all. Removing the 10,000 ohms resistance from the circuit, the insulated coil situated as described in the water, is substituted in its place. If the deflection in this case is only one division, then it is clear that 50 times the resistance is in place now. In other words, where 20,000 ohms gave 50 divisions, it has taken 1,000,000 ohms to cut this down to 1 division. Of the million ohms, 10,000 are due to the galvanometer resistance. The balance of 990,000 is the resistance of the hundred feet of insulated wire in the metal pail. As a single foot of wire would be higher than this; in fact 100 times as great, it may be stated that according to the test 1 foot of this wire has an insulation resistance of 100 times 990,000 ohms or 99,000,000 ohms, commonly called 99 megohms.



Finding a point on each wire which will cause no deflection of the galvanometer.

The Wheatstone Bridge.—This almost historic instrument is perhaps the most extraordinary device in the world. By its means, resistances can be measured with equal accuracy which express a range of difference equal to the ratio of $\frac{1}{1000}$ to a million. This ratio numerically is that of 1 to a billion and cannot be equalled by any simple device extant. It is as though a pair of scales could weigh with equal accuracy, one one-thousandth of an ounce and a million ounces. This extraordinary device is used for the purpose of measuring all kinds of resistances, high and low. The value of insulation resistances of the greatest figure are discovered by the preceding method. But for general resistance measurements, the Wheatstone Bridge is all comprehensive. It practically consists of a loop of wire so constructed that a galvanometer whose terminals rest on each wire of the loop respectively, will indicate the difference in drop between one part of the wire to which it is attached, and the part of the other wire to which it is similarly joined. For instance, if two parallel wires of a certain resistance carry a certain current, it is easy to realize that the terminals of a galvanometer will find a place on each wire respectively where the drop will be equal. Under these conditions no current could possibly flow into the galvanometer. If the upper or lower terminal of the galvanometer is shifted a trifle either way, it will take a potential either higher or lower than the other wire, and a current will consequently flow through the instrument. When the two points spoken of are found, however, the galvanometer remains unaffected. This condition was expressed by the saying that the A arm was to the B arm as the C arm was to the D arm. By this is meant that the resistance of A, B, C and D bear a certain relationship to each other. If they are given such values as 10, 20, 40 and 80 ohms; then 10 is to 20 as 40 is to 80. In other words, the ratio of A to B and C to D, and the fact that A is to B as C is to D, is only true when the galvanometer terminals reach these particular points where the "drops" of the two wires are alike. If the two wires are joined at each end to form a loop with the galvanometer between and a battery supplying the joined ends with current, then the conventional Wheatstone Bridge appears ready for service. In practice, the A and B arms express the ratio of 1 : 10 or 1 : 100 or 1 : 1000. The C arm is adjustable, so as to develop a balance between itself and the resistance to be measured. Supposing the A and B arms are set at the ratio of 1 : 100, then if the unknown resistance is inserted, and the C arm adjusted by manipulating the resistance it represents until the galvanometer does not show any deflection, the bridge is said to be balanced. If the balance was only possible when the C arm was made equal to 100 ohms, then the D or unknown resistance must be equal to 10,000 ohms. The method is simple enough if the necessary ratio of A : B = C : D is remembered. Carrying out this idea with A = 1, B = 10 and C = 100, will give 1 : 10 = 100 : D. According to these figures, the proportion will only be satisfied if D = 1,000 ohms. If the bridge is constructed with many A and B ratios, the range of measurement is thereby greatly increased.



Bridge balanced, by finding points marked equal potential for galvanometer terminals. The galvanometer is at rest.

* * *

THE SINGLE-PHASE RAILWAY SYSTEM IN ITALY.*

BY E. A. KERBAKER.

It is not uncommon in Italy to find towns of considerable importance which are lacking in facilities for intercommunication, on account of the mountainous nature of the country. In many instances the distance between a town and the nearest railway amounts to several miles, and generally there are gradients all along the route exceeding 1 in 10. Therefore traffic, even with carts, is laborious, and these places are in a very unfavorable position from an industrial standpoint.

Electric traction, in some instances, and motor-car services in others, have effected great improvements, having made it possible to develop traffic which it had been impossible to carry on with steam.

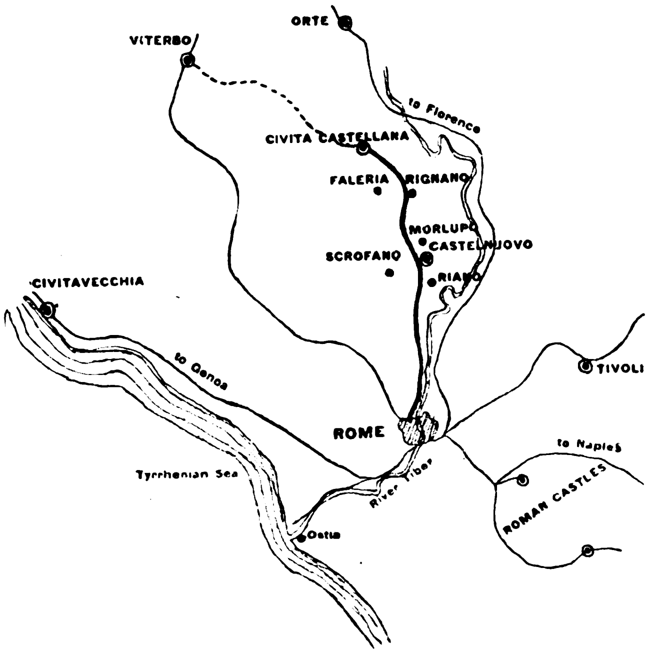


Fig. 1.

Where the traffic is of moderate density and the route long, a motor-car service has proved the more advantageous; but when, with given local conditions, the traffic exceeds a certain limit, electrical traction is found to be the more economical. The success attained by the single-phase motor during the past year has constituted a great step in advance in the field of electric traction, because, thanks to the moderate capital outlay, it is possible to adopt electric traction on many lines which, on account of their great length, would require with direct current working a number of costly feeders, as well as sub-stations and attendants.

In the district between Rome and Civita Castellana there are about a dozen little towns which, so far, have had no means of communication with Rome. Fig. 1 shows the different railways going from Rome to various neighboring places. All these railways are operated with steam engines, with the exception of a line going to the Roman Castles, which is approaching completion on the direct current Thomson-Houston system, and another line, the Roma-Civita Castellana, the construction of which has already been commenced and which will adopt the single-phase system of the Westinghouse Company. A description of the latter may be of interest, as it has been necessary to design for it many new details on account of the high voltage which has been chosen for the trolley wire.

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*From the "Electrical Review," London.

This line, which will be ready in six months, is nearly 33.5 miles in length; the line, hewever, will eventually reach Viterbo, when its total length will be over 46 miles.

Fig. 2 shows the mountainous nature of the district. Many stiff gradients are met with, including one of 1 in 14 for about ½ mile.

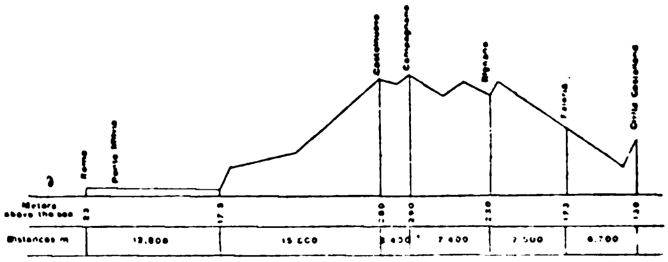


FIG. 2.

The traffic on this line will be conducted as follows: Between Rome and Ponte Milvio, an ordinary suburban service will be carried on with single cars weighing about 12 tons each when loaded; between Ponte Milvio and Civita Castellana, there will be two trains, each weighing about 20 tons fully loaded, and running at an average speed of nearly 15 miles per hour (maximum speed allowed, 22 miles per hour).

The power station will be at Ponte Milvio, 2.5 miles from Rome, and will be equipped with steam turbines of 300 hp. driving single-phase alternators at 25 cycles and 6,000 volts. The line between Rome and Ponte Milvio will be operated at 550 volts, the remaining section at 6,000 volts.

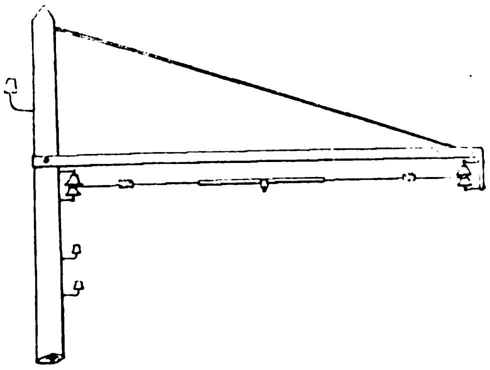


FIG. 3.

The track, which is single throughout the line, has a gauge of 1 meter. The rails are of the Phœnix type, weighing 70 lbs. per yard and 13 yards long, inside the town—say, between Rome and Ponte Milvio—for a length of nearly 2.5 miles. For the other part of the line—between Ponte Milvio and Civita Castellana—rails of the Vignoles type are used, 13 yards long and weighing nearly 42 lbs. per yard. The track is laid down on the existing roadway (the old Via Flaminia), and the ties are of oak of the best quality, 33 inches apart.

Only one side of the track is bonded, with the exception of the part of the line between Rome and Ponte Milvio. The bonds are of the Chicago type, fixed under the fish-plates on the inner side. Each bond weighs about 0.35 lb., and the distance between the two terminals is 8 inches. The bonding is done at the same time as the track is laid down, so as to insure economy and efficiency.

Between Rome and Ponte Milvio, where a pressure of 550 volts is used, there are two No. 00 trolley wires of copper of high conductivity. From Ponte Milvio to Civita Castellana there will be used only one No. 0 trolley wire. The former are fixed in the ordinary way, the latter, which is of a special figure-8 section, is attached to mechanical ears made of steel. As shown in Fig. 3, these ears are fixed to a steel wire capable of resisting a tensile stress of 2,700 lbs.

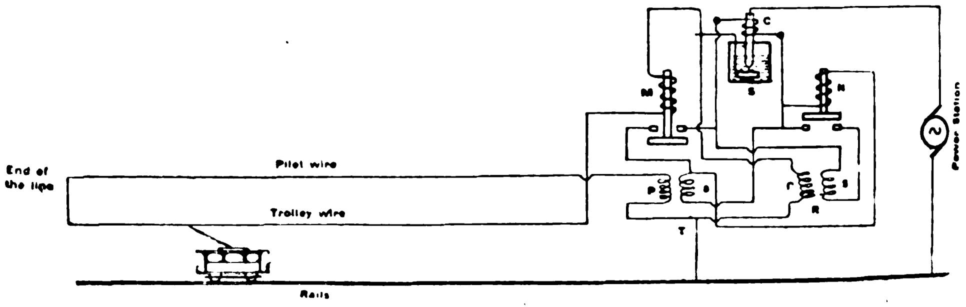


FIG. 4.

Double insulation is provided. The first is obtained by two special porcelain insulators, 5 inches high and 5 inches largest diameter; these insulators are fixed to the bracket arm by means of two bolts, and are tested before delivery up to 20,000 volts. The second insulation consists of two insulators, to the ends of which are fixed with a special cement two hooks for the steel wire; these insulators, before delivery, are tested with 40,000 volts.

The bracket arm is made of two flat iron bars, which are riveted together except at one end, where the bars are forged in such a way as to surround the pole, and are fixed to it with a bolt and nut.

The poles are of chestnut; their sizes are—total length, from 28 feet to 30 feet; top diameter, 5½ inches, bottom diameter, 11 inches. These poles are sunk in the ground to a depth of 5 or 6 feet. On straight track they are about 125 feet apart. Before erection, their lower ends are carbonized on the spot where they are to be erected.

As shown in Fig. 3, on each pole, besides the bracket-arm, there are fixed three insulators. Two of them are for the telephone service, the third for the pilot wire. Since this pilot wire must work at a pressure of 6,000 volts, its insulators have to be of the best quality. The pilot wire referred to is of No. 13 S.W.G., and is required for the actuation of a safety device, which is fixed at the power station.

Furthermore, the current must also be cut off in the case of a short circuit on the line, or of a current flowing in excess of the limits of safety.

Fig. 4 is a diagram showing the system adopted. The apparatus includes an automatic oil circuit breaker S, with its coil C, two electromagnets M and N, and two transformers T and R.

When the line is in its normal working condition, the current supplied to it goes through the electromagnet M, but is not strong enough for operating the latter, which, therefore, always remains open. On the other hand, the transformers T and R have their primaries always connected on 6,000 volts, so that at the terminals of their secondaries there is a certain pressure. Furthermore, the secondary of T is always connected with the terminals of the electromagnet N, and keeps its armature in the "open" position.

Suppose, first, that a short circuit happens on the line; then the electromagnet M, which is in series with the trolley wire, carrying a current stronger than the normal value, draws up the core and closes the circuit through the secondary of the transformer T and the coil C, thus opening the circuit breaker.

Suppose now that the trolley wire or the pilot wire breaks down at a certain point of the line. In this case, as the trolley wire and pilot wire are in series, no current will go through the primary of the transformer T, therefore the pressure at the terminals of its secondary become zero and no current can go through the coil of the electromagnet N. The core of the latter comes down, closes the circuit through the coil C and the secondary of the transformer R, and consequently trips the circuit-breaker.

One of the difficulties of the system described is its application at the turnouts, because if the two wires run in parallel, it is impossible to avoid danger due to the breakage of one of them.

It has been proposed, however, to use the arrangement shown in Fig. 5; by this means the safety of the system is maintained, but the construction of this part of the line requires much care and intelligent supervision.

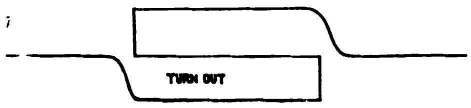


FIG. 5.

The line in question will have no feeders at all, a No. 0 copper wire being sufficient for the whole length with the high pressure used; every three miles there will be placed section insulators which consist of a neutral wire fixed to two or more poles, to which are fixed also the two ends of the live trolley wire.

At the point, however, where the change of voltage has to be effected, the neutral wire has a length of about 40 yards, and there is a special switch which can connect this wire with one or other of the two voltages but never both at the same time. This switch is erected just at the front of the power station and one of the station attendants will be intrusted with its operation.

The lightning arresters for the line will be erected at the places where section insulators are fixed.

The total seating capacity of each car will be about 40 people; the cars will each have four wheels. Each car equipment includes two 40 hp., 250-volt, 25-period, single-phase motors; one main transformer for primary pressures of 550 and 6,000 volts, and for a secondary pressure of approximately 250 volts; reversing switch; motor cut-out; air compressor; air reservoirs; complete Westinghouse brake equipment; and one bow-type trolley for high pressure, operated by compressed air.

The work of construction is now proceeding with great speed and it is generally expected that a portion of the line will be ready for next August.

On April 26 the first stone of the power station was laid in the presence of several Italian Ministers and other authorities, the Belgian bankers, who have provided the capital, and some hundreds of people who are anxiously awaiting the day of the inauguration of the system.

WRINKLES.*

EDITED BY H. C. ABELL.

Method of Protecting Separate Systems of Wiring When Crossing Each Other Without the Use of Guard Wires.

In many cases where high-tension lines cross over telephone and other signal wires, it has been necessary heretofore to erect an expensive system of guard wires. It has been found that the expense of this construction can be dispensed with, by the use of a device that automatically disconnects the wire at a point about two feet out from the cross-arm, so that the piece which falls across the signal wire is dead, and can therefore cause no harm.

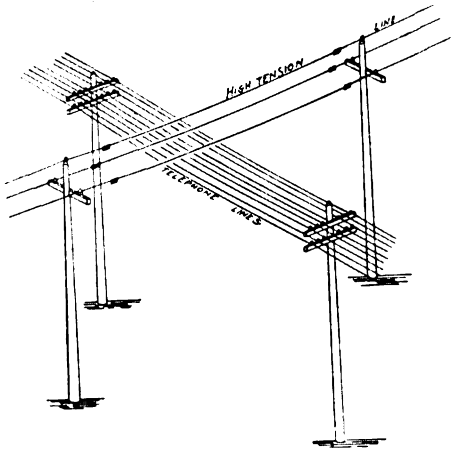


FIG. 1.—LINES CARRYING PROTECTING. DEVICE.

This device consists of a hook, so arranged in the lines that when the tension on the span is released the spring disengages the hook immediately, before the high-tension wire has had time to fall across the telephone line.

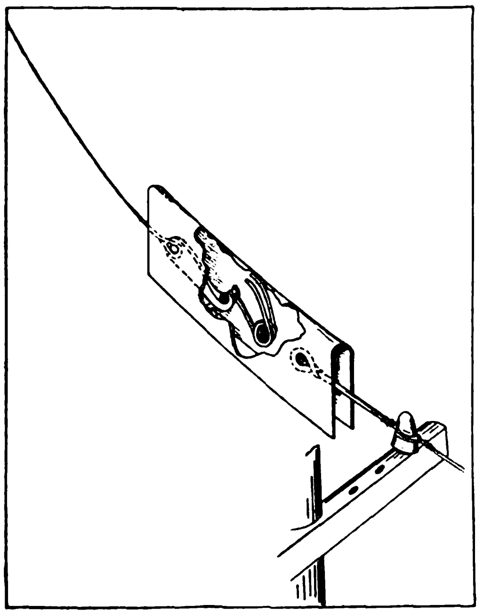


FIG. 2.—DETAIL OF PROTECTING DEVICE.

This hook is placed inside of a hood, which protects it from sleet or ice that otherwise might prevent its action.

The device is also of such a nature that it can be used by telephone companies in places where their wires are above the high-tension wires.

H. B. GEAR, Chicago, Ill.

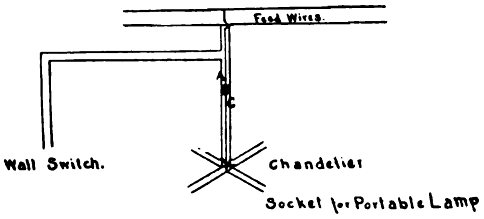
A Handy Chandelier.

The following description shows a handy arrangement for an electric chandelier in a library where a portable electric table lamp is used by connecting it to one of the chandelier sockets.

As most chandeliers are operated by a wall switch, all lamps in the chandelier are either turned on or off at the same time, and as a portable table lamp is often used when the rest of the lamps are not, it becomes necessary to turn off, one at a time, the other lamps when the table lamp is used alone.

By running an extra feeder wire to the chandelier, and a third wire through the chandelier to the socket from which the portable lamp is to be connected, the chandelier lamps and the portable lamp may be operated entirely independent of each other.

The following diagram will serve to illustrate the method of wiring:



CHANDELIER CONNECTIONS.

Care must be taken to get the portable lamp socket connected to wires B and C and not to A and C.

E. A. TAYLOR, Denver, Col.

Doubling the Efficiency of a Steam Radiator.

There are a good many rooms in Chicago apartments where the radiator is too small or the steam pressure too low to maintain a comfortable temperature in severe weather. If the tenant is enjoying the many advantages afforded by central station electric lighting service the matter can easily be remedied.

Take the fan that kept you cool all summer and set it where it can blow against a large part of the radiator's sur face. Turn it on at low speed, or at high speed if necessary, and your cold room will soon be thoroughly warmed.

The philosophy of the thing is that

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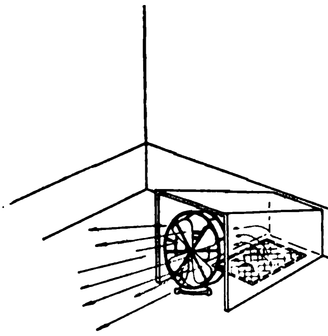
*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11, 1905.

steam at a low pressure carries much less latent heat than steam at a high pressure, and therefore warms the radiator so poorly that only a slight draft of air rises around the pipes, and condensation is slow.

With the fan in operation there is a forced draft against the radiator that conducts a great deal more heat away from the iron, cooling it so that much more condensation of steam occurs inside it. The heat thus snatched from the reluctant radiator is held in the circulating atmosphere of the room, which is soon changed from cold to warm at a trifling cost for electric energy.



The condensation of the steam makes room for more steam to flow in, and the net result is the same as if the pressure was much higher. C. H. Stewart.

THE CHOICE OF AN INSULATED CABLE.*

BY WALLACE S. CLARK.

Every plant generating electric current uses insulated cables—in many cases only for station wiring; in others for its entire distributing system. The company that buys 25 miles or more of cable each year can and does devote a liberal allowance of engineering skill to the selection of the best and most economical types. There are a very large number of plants of moderate size that, with the growth of their business and the increasing tendency to substitute underground for overhead construction, are compelled to increase continually their investment in this line. Some of the points covered in this paper will, I hope, be of value to those responsible for the success of such plants.

The size of the conductor is determined by well-known methods, therefore it is only necessary to emphasize some points usually overlooked. There are two distinct conditions of service. One where the amount of current is not subject to any probable increase, such as instrument, generator and transformer leads; the second comprising all lines outside of the station that may be subjected to increasing loads due to the growth of business.

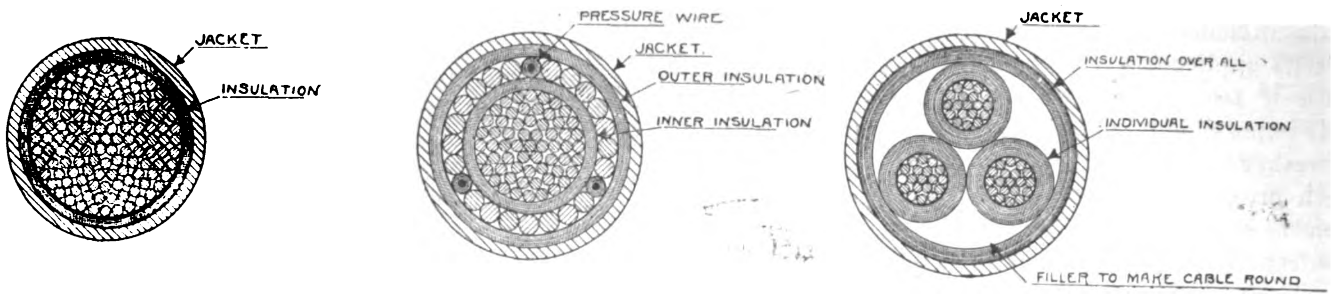


Fig. 1.—Three Cable Sections.

For the first-class ampere (current carrying) capacity, or mechanical strength in the case of small apparatus, is the determining factor. The current-carrying capacities given in the National Electric Code for rubber insulation are a fairly safe guide and the current densities given should not be exceeded.

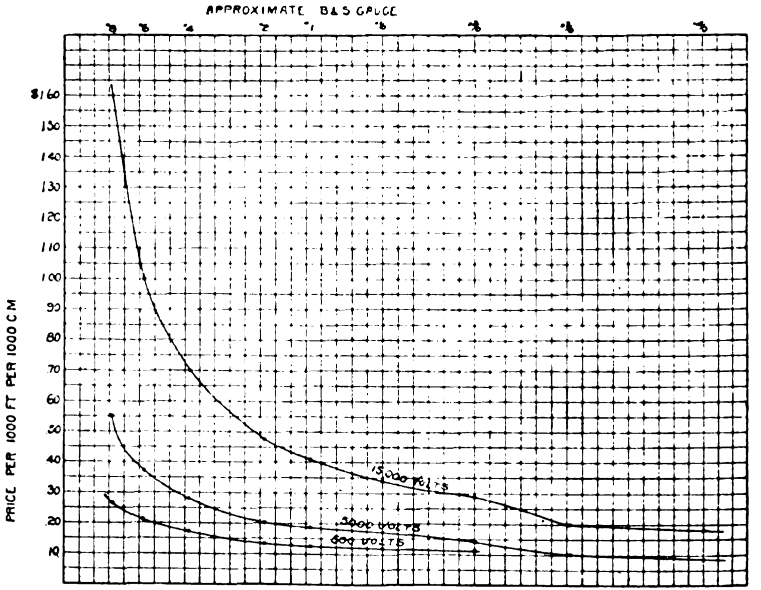


Fig. 2.—Variation in Cost per 1,000 cm. of Copper for Different Sizes of Cable and Different EMF.

For the second class of conductors, the cost of power at the switchboard, the load factor of the line, the limits of loss in transmission for satisfactory regulation of potential and operation of consuming device, the heating of the cable in short lines, the probable increase in load with time and the interest charge on the cable investment are the principal factors in settling the size of conductor to be used. The Thomson law, so-called—that the most economical arrangement is where the cost of the power wasted and the interest charge on the cable investment is a minimum—is the basis of many formulæ elaborated in different books.

Having determined the size of conductor required on theoretical grounds, consideration should be given one or two very practical points. First, do not use for underground construction cables so small as to be mechanically weak. I have in mind a station with a 6,600-volt distribution where the cables ran from three-conductor 0000 to three-conductor No. 6 in size, the No. 6 constituting the smallest part of the installation and giving more trouble than the entire remainder of the system.

Second, if you use a duct system, keep in mind the fact that the cost of duct per foot is independent of the size of the cable in the duct, and select the size of conductors so that the cables will utilize a reasonable proportion of the duct area. Two No. 8 arc-light cables, single-conductor, in a 3-inch duct, costing from 20 to 40 cents per duct foot is evidently uneconomical. The standard 3-inch duct will take cables of the following sizes, insulated for different voltages: Any voltage under 1,500, single-conductor cables up to 2,000,000 circular mils; concentric two-conductor cables up to 1,000,000 circular mils; three-conductor cables up to 500,000 circular mils.

For 3,000 volts, single conductors up

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*Paper read before the National Electric Light Association at its 28th convention, held at Denver-Colorado-Springs, Col., June 6-11, 1905.

to 1,500,000 circular mils; concentric up to 750,000 circular mils; three-conductor up to 400,000 circular mils.

For 6,600 volt lines, which are practically all three-phase, the limit is found at three-conductor 250,000 cm. cable; 12,000 volt lines, the limit is found at three-conductor No. 0000 cable; on 24,000-volt lines at about 100,000 cm. cable. It is assumed, of course, that the three-conductor cables are run on delta-connected circuits and have the same wall of insulation between conductors and ground as between the conductors themselves. If the three-phase circuit is run Y-connected with neutral grounded, then the outer jacket of the three-phase cable can be made considerably less in thickness and larger cables be installed in the standard 3-inch duct.

Fig. 2 gives some curves showing the variation in cost per 1,000 circular mils of copper contained in the cable for different sizes of cables and different working EMF. It will be noted that the lack of economy in the use of small conductors is most marked in the 15,000 volt class, where changing the size from No. 8 to No. 6 wire increases the cost less than 4 per cent, while the conductivity is increased 58 per cent. Or, taking the larger sizes and going from No. 1 to No. 0, the cost is increased 8 per cent. and the conductivity 26 per cent.

These figures and curves are based on varnished cambric cable, as this type of insulation is roughly midway in price between good rubber cable and good paper cable. With paper insulation the comparison would be less favorable to the larger conductors, while with rubber insulation the use of the larger conductors would show much greater economy.

There is another point especially noticeable in the use of potentials above 5,000 volts, and that is that the safe working pressure for a given thickness of insulation is less in the very small sizes of conductor. Or, to put this in another way, where the thickness of insulation exceeds twice the diameter of the copper core in high-potential cables with homogeneous insulation, we are not able to get the full advantage of the insulating wall, since the fall in potential, or potential gradient, is undoubtedly higher in the layer of insulation immediately adjoining the copper than it is half way between the copper and the outside of the cable; this concentration of pressure tending to break down first the inner layers of the insulation and finally puncturing the entire insulating wall. In short, it is easier to make a 500,000 cm. cable for 10,000 volts working pressure than to insulate a No. 14 wire for the same purpose.

The next point to be covered is whether single or multiple-conductor cables should be used. For station wiring single conductors in separate ducts, or runaways, might safely be taken as the best modern practice. Maximum safety and reliability, and simplicity of arrangement, appear to have settled this question pretty definitely. For outside lines the service will largely decide. Direct current railway feeders are normally single-conductor.

When ducts are high in cost and the load on one feeder is not heavy enough to require a cable utilizing most of the duct space, two feeders may be combined, as long as their course is parallel, in a concentric type of cable if it is desirable to preserve their identities to the switchboard. If it is not important to run the cables as separate feeders back to the switchboard, we may bunch two or more cables by means of a junction box into a single large cable which will run back to the generating plant; as, for instance, three 500,000 cm. cables might be multiplied and a 1,500,000 cm. cable run back to the station. This cable is readily installed in a standard three-inch duct, and there would be a saving in first cost of cable, in duct investment and in switchboard.

For low-tension mains on the three-wire system, either three single-conductor cables or one three-conductor cable can be used. The three-conductor cable is slightly cheaper in first cost but not nearly as convenient for making taps to customers. Theoretically, with alternating currents there is a slight advantage in the use of the three-conductor cable. For low-tension feeders, which usually exceed 250,000 circular mils, in size, the concentric type of cable should be used for maximum duct economy. Smaller than 250,000 cm. cables may be run as a flat twin conductor, and this type of conductor is always advisable for alternating current feeders with manhole transformers. It should be noted here that it is a modern practice, and one to be commended, in running a three-wire system to ground the neutral and run the feeders simply as a two-wire feeders, providing a tree or trunk neutral to which the different points of distribution are connected and which runs back by means of a very heavy cable to the station.

The common practice in arc circuits is to use single-conductor cable. Where a number of circuits are in parallel for any distance an excellent plan is to combine them into a multiple-conductor cable.

(To be continued.)

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JUNE 13, 1905.

Electric Railways and Appliances.

792,122. System for Transmitting Electric Currents to Cars. John J. Eagan, San Francisco, Cal. Filed Feb. 2, 1905.

792,174 Electric Railway-Switch-Operating Device. Charles W. Squires, Springfield, Mass. Filed May 16, 1904.

792,176 177-178. Power-Driven Trolley-Head and Electrically-Propelled Carrier. William J. Sumner, Holyoke, Mass., assignor to the Coburn Trolley Track Manufacturing Company, Willimansett, Mass. Filed Nov. 14, 1904.

792,279. Electric Block-Signaling System for Railways. Claud D. McPhee, Arnprior, Canada, assignor of one-half to John Carling Kelly, Ottawa, Canada. Filed July 1, 1904.

792,569. Electric Railway. William Chapman and Percy W. Davies, Pittsburg, Pa.; said Chapman assignor to the Westinghouse Electric & Manufacturing Company. Filed Nov. 23, 1897. Renewed April 12, 1905.

Electric Lights and Appliances.

792,076. Electric-Arc Lamp. Robert H. Read, Schenectady, N. Y., assignor to the General Electric Company. Filed Oct. 10, 1902.

792,225. Wall-Plug for Incandescent Electric Lamps. Charles J. Malish, Toledo, O., assignor of one-half to Louis Bergman, same place. Filed Oct. 31, 1904.

Electrical Machinery and Apparatus

792,016. Transformer-Lead. John J. Frank, Schenectady, N. Y., assignor to the General Electric Company. Filed Nov 16, 1904.

792,020. Circuit Breaker and Closer for Alternating-Currents. Andrew Gray, London, Eng., assignor, by mesne assignments, to the Marconi Wireless Telegraph Company of America. Filed Sept. 7, 1904.

792,035. Synchronizing Device. John D. Hilliard, Jr., Glens Falls, N. Y., assignor to the General Electric Company. Filed Nov. 23, 1904.

792,087. Thermo-Regulator for Vapor-Burners. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed May 24, 1900.

792,091. Constant-Current System. Matthew O. Troy, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 12, 1903.

792,102-103. Alternating-Current Motor and Alternating-Current-Motor Control. Gabriel Winter, Vienna, Austria-Hungary, and Friedrich Eichberg, Berlin, Germany, assignors to the General Electric Company. Filed Nov. 14, 1904.

792,195-196-571. Rotary Mercury Circuit-Breaker and Electric-Motor System. Adolph F. Christmas, Pittsburg, Pa., assignor of two-thirds to Frank R. McFeatters, Wilkinsburg, Pa. Filed Aug. 15 and Sept. 23, 1904.

792,425. Electric Cut-out Box. Anton T. Kliegl and John H. Kliegl, New York City. Filed Aug. 4, 1904.

793,463. Alternating-Current Motor. Leo Schuler, St. Louis, Mo. Filed June 17, 1904.

792,530. Electric Fuse. Norman Marshall, Newton, Mass. Filed June 27, 1903. Renewed May 20, 1905.

Telephones and Telephone Apparatus

792,248. Induction-Coil. George A. Campbell, Newton, Mass., assignor to the American Telephone & Telegraph Company. Filed Oct. 8, 1904.

Miscellaneous.

791,938. Resistance for Rheostats and Electric Heaters. Henry P. Ball, New York City, assignor to the General Electric Company. Filed Nov. 23, 1904.

792,001. Film-Coated Wire. John G. Callan, Lynn, Mass., assignor to the General Electric Company. Filed July 25, 1903.

792 014. Transmitting Apparatus for Wireless Telegraphy. John A. Fleming, University College, London, Eng., assignor, by mesne assignments, to the Marconi Wireless Telegraph Company of America. Filed Sept. 7, 1904.

792 025. Means for Protecting Electric Circuits. John Hamilton, Jr., Boston, Mass. Filed Oct. 16, 1903.

792,052. Electric Telegraphy. Isidor Kitsee, Philadelphia, Pa. Filed March 16, 1905.

792,066. Electrical Harness. William D. McGregor, Slocan, Canada. Filed Dec. 5, 1904.

792,162. Electric Osteophone. La Forest Potter, New York City. Filed June 15, 1904.

792,191. Galvanic Battery. Benjamin J. Blameuser, Chicago, Ill. Filed Aug. 1, 1904.

792,255. Electric Furnace. Francis A. J. Fitz Gerald and Peter M. Benne, Niagara Falls, N. Y. Filed Dec. 3, 1904.

THE TELEPHONE WORLD.

New Independent Company for Ohio.

The formal organization of the Northern Ohio Telephone Company was effected lately with the election of the following officers: President, Willard F. Robison; vice-president, H. M. Perrin, of Maumee; treasurer, James S. Brailey, Jr.; secretary, Charles F. Chapman; directors, the foregoing, together with N. L. Hanson, of Perrysburg; T. H. Tracy, Clarence Brown and M. G. Bloch.

The Northern Ohio is the Independent Telephone Company that was recently formed to take over the exchanges at Perrysburg, Maumee and Whitehouse. It is capitalized at $100,000, and it is the intention to acquire other exchanges in Lucas, Wood and Fulton Counties. The company is owned by the same interests that control the Toledo Home Telephone Company, with which plant it will work in harmony.

Quite a stir was created in telephone circles of Toledo when the fact became known, some months ago, that the Independent had acquired the exchange at Perrysburg. Heretofore this plant, which was practically the key to the rich Wood County oil field, was identified with the Bell interests, but the Toledo Home capitalists secured control of the stock, and thus added a rich feeder to the local plant.

The Bolivar, N. Y., Telephone Company has purchased of George E. DeGolia and others, the Oswayo Valley Telephone Company's plant. It is the intention of the Bolivar Telephone Company to greatly improve the local and toll service of its newly acquired line and to extend the service into several new country districts. The new line will be conducted independently of the local line and will retain the name Oswayo Valley Telephone Company.

About 30 members of the Missouri Independent Telephone Association met recently in Sedalia for the purpose of revising the constitution and by-laws of the association to give greater scope to the Independent companies. President Garry, of Macon, presided, and Frank S. Leach, of Sedalia, was secretary. One of the changes in the constitution will enable the Missouri Association to become a member of the National Interstate Association whenever it may be deemed advisable.

The Superior, Wis., Telephone Company will erect a brick building this summer in which will be installed the company's exchange. The building, according to the company's plans, will be modern in every respect. It will be constructed of brick and stone and is to have two stories and basement.

News from Winnipeg, Manitoba, states that Robert Rogers, minister of public works, recently announced at Melita that Manitoba will take steps to provide for Government ownership of telephones in the province and tax all public franchises. A keen fight with the Bell Company is in prospect.

The office for the new telephone exchange at Oneonta, N. Y., will be one of the most model in the State, and will have accommodations for 3,000 telephones.

Union Pacific to Use Telephones.

The Union Pacific is to operate over all its lines a telephone system for the operation of trains. It will not supplant the telegraph, but will be supplementary. All trains will be equipped with telephones, which can be attached to the wires at any point for use in case of accident.

The company has been experimenting with the telephone for two years, using its telegraph wires to advantage. It works best for short distances, but by means of relays it can be used advantageously over the whole system.

The purpose of the National Interstate Telephone Association, which is the organization of Independent telephone companies of the country, and now holding its eighth annual convention in Chicago, is to effect among the various Independent interests a closer and more militant organization for successfully meeting opposition. The situation in the United States, according to Government reports and other authorities, show the Independents to have 2,500,000 telephones and invested capital of $250,000,000 as against 1,800.000 other telephones and invested capital of $400,000,000.

At the annual meeting of the Ontario & Steuben County Telephone Company, held in Naples, N. Y., a short time ago, steps were taken to greatly enlarge the scope of the company's business by increasing the capital stock to $30.000 under a new corporation. Its once small line has stretched out its arms in every direction, and the demand for its services has forced this enlargement. The number of shares will be increased from 65 to 2,000.

It is estimated that $200.000 in expenditure will be involved in the construction of the new plant of the Independent Telephone Company, of Council Bluffs, Ia. Clarence Judson has been selected as chief engineer of the construction work and toll lines, and he thinks the construction will be completed sufficiently by Christmas to permit the opening of the exchange for business.

Steps are being taken by the City Mutual Telephone Company, of Humboldt, Neb., to practically rebuild its system, putting in a new switchboard, cables, poles, lines, etc,

A report from Bloomington, Ill., states that a syndicate of which Adolph Busch, of St. Louis, is a member, has bought up the Home Telephone property, and will greatly improve the service, especially that part in Normal. It will become a part of the Kinloch Syndicate.

R. A. Nix is putting in a telephone exchange at Montague, Tex. He will also have charge of the long distance to Nocona and Bowie, and the local lines running to Mallard and Dye.

The Corning, N. Y., Telephone Company has opened its new long distance line to Lindley by way of Spencer Hill, Caton and Browntown.

A new law has gone into effect in California, which makes it an offense punishable by imprisonment for anyone to eavesdrop on a telephone line and then discuss the conversation.

Toll Line Clearing House.

At its recent meeting in Des Moines, the Iowa Toll Line Telephone Company decided to incorporate a clearing house company with a capital stock of $10,000. A committee of five was appointed to draft the constitution. The clearing house will be located in Des Moines. The committee appointed was made up of C. C. Deering, of Boone; E. H. Martin, of Webster City; P. A. Holdoegel, of Rockwell City; J. M Plaister, of Fort Dodge, and C. G. Cockerell, of Jefferson.

The representatives of 16 Iowa toll line telephone companies were in attendance at the meeting. The clearing house will make out the regular reports for the companies, saving each one the trouble of making out its own report as well as reports of companies doing business over its line and of those over whose lines it does business.

The deal on the part of the Rochester, N. Y., capitalists to acquire the Syracuse Telephone Company has been consummated. George R. Fuller, manager and treasurer of the Rochester Telephone Company, and a director in the Independent Telephone Securities Company, states that he has acquired options on all the stock of the Syracuse company, with the exception of 150 shares. Thousands of dollars will be spent in Syracuse, and the construction of a new and up-to-date telephone system in that city will unite in one control the Independent telephone interests of Rochester, Syracuse and Utica.

The incorporators of the Coos County, N. H., Telephone Company have organized with the following officers: President, Garvin R. Magoon; secretary, John T. Amey; treasurer, John C. Hutchins. The purpose of this company is to give the people of Coos County better and cheaper telephone service, enlarging the free service circuit so that it will include the entire county. The president, Mr. Magoon, says that prompt measures will be taken towards perfecting the service either by leasing or buying the New England telephones out or by building new lines.

At the annual meeting of the stockholders of the Keya Paha and Brown County Telephone Company, held this month in Ainsworth, Neb., the following officers were elected: President, Charles Hineman; vice-president, Frank Sellors; secretary, F. A. Baldwin; treasurer, R. E. Jones.

The Home Telegraph & Telephone Company, of San Francisco, Cal., it is announced, will construct a line from San Francisco to Portland Ore , to compete with the Sunset Telephone Company.

Telephone Incorporations.

The Wire & Telephone Company, of America, Rome, N. Y. Capital stock, $600,000. Directors: C. F. N. Niles, Toledo; J. S. Dyett, Rome; S. C. Houghton, Syracuse.

The Hammonton Telephone & Telegraph Company, Hammonton, N. J. Capital stock, $125,000. Incorporators: Andrew J. Rider, Samuel Anderson, Marcellus L. Jackson, Richard J. Byrne and L. Frank Horne, all of Hammonton.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Andover, N. Y.—The Andover Electric Power & Light Company, capitalized at $10,000, has been incorporated by R. A. Stout, A. B. Richardson and J. H. Backus, all of Andover.

Ballard, Wash.—The question of electric lights for this city is now being agitated by people living on the outer edges of the city. Many districts are not served with lights, and an effort will be made to have the council contract for more lights.

Burlington, Wis.—A special election will be held to-day to vote on bonds for this city for a $12,000 municipal lighting plant.

Campbellsville, Ky.—The Campbellsville Electric Light Company was organized for the purpose of putting into operation an electric light plant in this city. Dr. J. L. Atkinson was elected president; J. R. Davis secretary and treasurer, and B. S. Kincart, superintendent and general manager. The capital stock has been subscribed, and the company hopes to have the plant in operation by August 10.

Chetopa, Kan.—The proposed waterworks and electric light plant will cost $29,500. No engineer has been selected yet. A. R. Bell is city clerk.

Cleveland, O.—The Cleveland Electric Illuminating Company will erect a sub-lighting station here.

Colma, Cal.—This town will soon have electric lights.

Creston, Ia.—This city will have a new electric light company. The organization was launched with an authorized capital of $50,000. The sum of $21,000 is now subscribed. The following officers have been elected: President, J. C. Sullivan; vice-president, C. S. Rice; secretary, Dr. J. W. Reynolds; treasurer, John Hackett.

Elk Rapids, Mich.—The citizens are about to vote on bonding this city for $20,000, for an electric lighting system.

Murfreesboro, Tenn.—At a meeting of the board of mayor and aldermen of this city a 10-years' contract was made with the City Gas & Electric Company, of which J. H. Nelson is proprietor, to supply lights for that time. The arc light system will be installed without any increase of the tax levy.

Newark, N. Y.—A Philadelphia syndicate headed by E. E. Mandeville, a prominent engineer and electrician, has purchased the electric light plant here for $75,000.

Pana, Ill.—The Pana Gas & Electric Company has been incorporated by T. F. Russell, William Pierce and others.

Prospect, O.—The Prospect Electric Light & Power Company has increased its capital from $10,000 to $20,000.

Santa Ana, Cal.—It is stated that bids will be received by Edward Telford, city clerk, until July 3 for $57,000 electric light bonds.

Smith's Station, Pa.—Penn Grove Park, the well-known camp-meeting grounds here, will be lighted by electricity at an early date.

Van Horn, Ia.—This city is to have an electric light plant.

Yankton, S. D.—After several years of constant discussion, in which municipal or private ownership has been the bone of contention, the city council has taken action and granted a 20-years electric lighting franchise to Sandford G. Donaldson and his assigns, the franchise carrying an option on the part of the city to purchase the plant in 10 years' time at its actual value if it sees fit.

STREET RAILWAYS.

Auburn, N. Y.—The Auburn & Northern Electric Railway Company, which was recently granted a franchise to construct two new trolley lines in this city, is considering the proposition of constructing a trolley line from here to Cayuga.

Baltimore, Md.—The Washington, Baltimore & Annapolis Electric Railway Company has effected financial arrangements for the completion of a double-track electric railway between this city and Washington.

Beatrice, Neb.—A proposed electric line 110 miles long is to run from this city south to Carlton, Kan., where it will connect with the Missouri Pacific. A charter for the road has been asked for, and the capital stock will be $1,500,000. The officers of the road, which will be known as the Golden Belt Railroad, are J. C. Morrow, president; J. E. Brewer, treasurer, and George W. Hanna, secretary.

Bennington, Vt.—The directors of the new electric road from this city to North Adams, expect to have work begun on the line within a short time and to have the road in operation within the year.

Bucyrus, O.—A mortgage for $250,000 has been recorded here, given by the Marion-Bucyrus Electric Railway Company to the Cleveland Trust Company. The railway company is building an electric line from Marion to this city via Caledonia. Several miles of the road has already been graded and a few rails laid. Ellis Bartholomew is at the head of the company.

Canal Dover, O.—An electric line is proposed from this place to Lisbon.

Coffeyville, Kan.—The new electric railroad between this town and Independence, now in process of construction, is expected to be completed and cars running by October 1.

Erie, Pa.—The Corry, Findley Lake & North East Trolley Company will accept the franchise to enter this city.

Gainesville, Tex.—The city council at its regular meeting this month by a unanimous vote granted Judge Hassinger and associates a franchise for an electric line. This is the Gainesville-Sherman Interurban.

Galion, O.—According to announcement made by W. L. Ball, all details for the early construction of the Galion Southern Electric Railway are completed, and work will begin at an early day. The road will run from this city via Frederickstown to Mt. Vernon.

Guadalajara, Mex.—Arrangements are being made for the transferring of the concession for the construction of an electric railway from this city to Chamela, on the Pacific coast, which was obtained by M. C. Miller, of Minneapolis, Minn., to the Jalisco Rapid Transit Company, which is in process of organization. Application for a charter for the company, which will be capitalized at $15,000,000, will be made shortly in the State of South Dakota.

Humboldt, Tenn.—Local capitalists and promoters are interested in another electric railroad from this city to Memphis. The proposed route is via Alamo, Maury City, Brownsville, Phelan, Wrights, Bolton and to connecting points at Raleigh Springs with the electric road to that place. Men of influence and financial ability are behind the movement, and from the assurance already at hand the success of the road is certain.

Indianapolis, Ind.—Plans are being made by the recently organized Huntington, Columbia City and Northwestern Traction Company, to build a line from Goshen to this city by the way of Columbia City, Huntington, Marion, Elwood and Noblesville,

Jasper, Ark.—The proposed electric railway from Fort Smith via this place to St. Joe is now a certainty, and work will soon begin on its construction.

Lander, Wyo.—A movement is now on foot to establish an electric line from Rock Springs to this place.

Millville, N. J.—There is talk of building a trolley road from here to Port Norris by way of Mauricetown and Haleyville.

New Castle, Pa.—The $6,000,000 merger of the Pennsylvania & Mahoning Valley and of the New Castle & Sharon Interurban Electric Lines, is fast nearing completion. The articles of incorporation have been received from Harrisburg. The shares are $10.

Oklahoma, Okla.—Work on the construction of the interurban electric line to connect this city, Edmond and Guthrie, will be commenced here in about two weeks.

Rochester, N. Y.—The New York Central Railroad Company has been negotiating with the Clark Syndicate, owning the Rochester Railway Company, and several suburban lines, for the transfer of all the railroad interests held by the Clarks in this city and vicinity.

Sacramento, Cal.—The board of supervisors has lately adopted a resolution agreeing to sell to the highest bidder a franchise to construct and operate an electric railway along Cypress avenue, in Oak Park, and then down the Upper Stockton Road, for a distance of 1,000 feet. Bids will be opened at the meeting of the board July 8.

St. Joseph, Mo.—Mrs. Alice M. Butler, general manager of the proposed St. Joseph, Stanberry & Northern Electric Line, has signed a contract with a St. Louis Trust Company to advance $566,000, two-thirds of the estimated cost of constructing the line. The remaining third, she says, will be advanced by persons and interests in this city, Stanberry, Des Moines, and other points where she is known. The estimated cost of building the line is $850,000.

Toledo, O.—At a recent meeting of financiers at Lima, the plans for an electric line between Lima and this city were discussed.

POWER PLANTS.

Boulder, Col.—The power plant of the Fourth of July Mining Company was recently destroyed by fire, entailing a loss of $6,000.

Reading, Pa.—Because of the increased demand for power and for illuminating purposes, the directors of the United Traction Company have decided to construct an additional plant of 10,000 hp. along Tulpehocken Creek.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15@15⅛c.; Lake 15⅛@15¼c.; casting, 14¾@14⅞c.

The Philadelphia Electric Company last week paid out $250,000 in the form of its semi-annual dividend.

At a recent meeting of the board of directors of the Chicago Edison Company the retiring officers were re-elected.

The capital of the Morris County Traction Company of Morristown, N. J., has been increased from $250,000 to $2,750,000.

The adjourned special meeting of the Mexican Telephone Company will be held at the Astor House, New York City, June 29.

It is said that the Keystone Telephone Company of Philadelphia has sold $4,000,000 first mortgage 5 per cent. bonds to a New York syndicate.

The Washington, Baltimore & Annapolis Electric Railway Company has filed a mortgage to secure $1,000,000 second mortgage 5 per cent. 25-year bonds.

The Western Union Telegraph Company has declared the regular quarterly dividend of 1¼ per cent., payable July 15. Books closed June 20 and reopen July 1.

The Bangor (Me.) Railway & Electric Company has made a mortgage to secure $2,000,000 five per cent. 30-year bonds, subject to call at 107½, of which $800,000 are outstanding.

The directors of the Manchester (N. H.) Traction, Light & Power Company have declared a regular quarterly dividend of 1½ per cent., payable July 15 to stock of record July 1.

The Rochester, Syracuse & Eastern (N.Y.) Electric Railroad has filed a mortgage to secure not over $7,500,000 five per cent. bonds redeemable at 110 after 1915. The bonds are for construction.

The American Telephone & Telegraph Company has declared the regular quarterly dividend of 1½ per cent. and an extra dividend of ¾ of 1 per cent., payable July 15. Books close June 30 and reopen July 15.

The Charleston & Summerville (S. C.) Electric Railway Company has made a mortgage to secure $1,000,000 five per cent. 30-year bonds, redeemable at 110, for the construction of its proposed lines.

Trustees of the Boston & Worcester (Mass.) Electric Company have declared a regular semi-annual dividend of $2 on the preferred stock, payable July 1 to stock of record at the close of business June 24. The initial dividend on this stock was declared one year ago, this being the third payment.

First mortgage bonds of the Portland (Ore.) General Electric Company to the amount of $4,000,000, secured by a first and only mortgage on all property of the company, operating under perpetual franchises, are being offered to investors by N. W. Harris & Co. of New York. The company controls the electric light and power business of the city of Portland and surrounding territory.

Kuhn, Loeb & Co. have bought from the Metropolitan Street Railway Company of New York $1,250,000 of its 4 per cent. bonds, the proceeds of which will be used to retire certain bonds maturing in July. The bankers named have, therefore, bought all the bonds of the Metropolitan Street Railway system, from which fact Wall Street naturally is inclined to think they are favorably disposed to that company and the Ryan interests.

ELEOTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price June 17
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	202¼
Manhattan Elevated Railway	162¼
Metropolitan Street Railway	122¾
Metropolitan Securities	79
Ninth Avenue	197
Third Avenue	126
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	63⅜
Brooklyn City Railway	240
New Orleans Railway	..
Public Service Corporation (New Jersey)	121
Philadelphia.	
Consolidated Traction of New Jersey	83¼
Philadelphia Traction	99½
Union Traction	62¾
Boston.	
Boston Elevated	157
Massachusetts Electric Companies, com	19¼
do. do. do. pref.	66½
West End Street, com	96¾
do. do. do. pref.	116½
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	6
do. do. pref.	38

ELECTRIC MANUFACTURING COMPANIES' STOCKS.

Name.	Closing price June 17
New York City.	
Allis-Chalmers, com	13⅝
do. pref.	51⅛
Electric Boat, com	34
do. do. pref.	75
Electric Lead Reduction	½
Electric Vehicle, com	16
do. do. pref.	20
Westinghouse, com	168
do. pref.	190
General Electric	176½
Boston.	
Edison Electric Illuminating	245
General Electric	166½
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	155
National Carbon, com	62½
do. do. pref.	118
Philadelphia.	
Electric Company of America	11½
Electric Storage Battery, com	80
do. do. do. pref.	80

TELEPHONE AND TELEGRAPH STOCKS.

Name.	Closing price June 17
Boston.	
American Telephone & Telegraph Company	140½
Western Telephone Company	17¾
New England Telephone Company	138½
New York.	
American Telegraph & Cable Company	90½
Commercial Cable Company	210½
Mexican Telephone Company	1⅛
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	94⅝
Chicago Telephone Company	135

MISCELLANEOUS STOCKS.

Name.	Closing price June 17
Otis Elevator Company	51
Consolidated Car Heating	64
Standard Underground Cable	200

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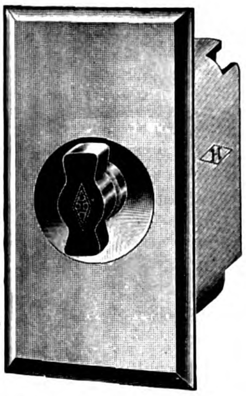

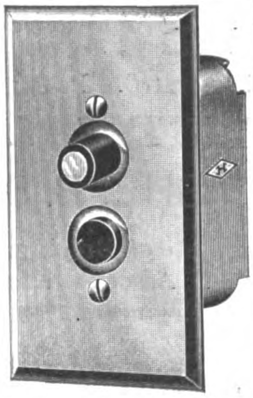

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J. D. KEILEY,

Assistant Electrical Engineer N. Y. C. & H. RR.

The absence of a modern treatise on electric railways, embodying all the recent developments in electric traction, has encouraged the authors in the preparation of this book. Their aim has been to treat the subject from the theoretical and practical sides. Realizing the immensity of the traction field and the urgency of the demand for information on this subject, the authors have restricted their efforts in the present volume, to the treatment of rolling stock, and have added thereto a chapter treating, mathematically, the speed time and power curves. It is their intention, should the reception of this volume be encouraging, to follow it by succeeding volumes covering the entire field. Much information has been culled from the publications of engineering societies and other sources in an effort to include in the work the most modern of railway data.

CONTENTS:

Units and Measuring Instruments: Mechanical. Electrical. Slide Rule, Planimeter.

Train Performance: Speed Time Curves. Power Curves. Equipment Calculations. Indicating and Recording Instruments. Curve Plotting.

Car Construction: Trolley and R. R. Tractive Force, Resistance, etc. Journals, Axles, Gears, Friction, Car Trucks, Strength, Durability. Lubrication and Testing. Control of Air, Air Pumps, Governors, etc. Brakes, Brake Apparatus, Brake Shoes. Platforms, Gates, Heating.

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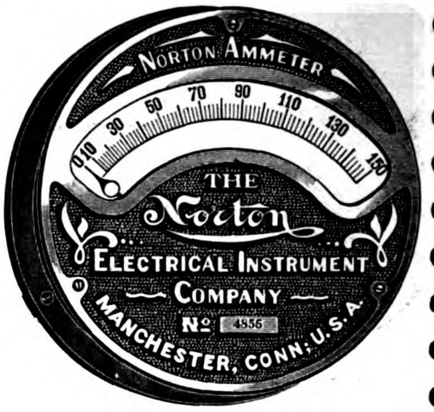
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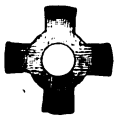

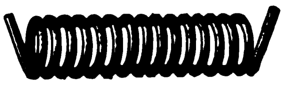

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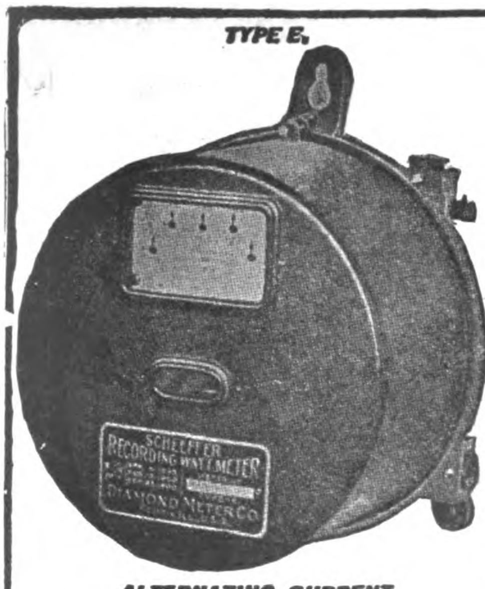
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EDITORIAL NOTES.

The Subway in Summer.

Before the Rapid Transit Subways in New York were completed a well-known engineer made the remark that the atmosphere in the tunnels would be warmer in winter than the outside air and several degrees cooler in summer. Experience has shown that the air of the Subway is warmer in cold weather, but it has also been demonstrated that it is warmer than the outside air in summer. This is an unlooked for and unpleasant state of affairs, and to make matters worse the air is contaminated by odors emanating from hot oil and grease.

The trouble undoubtedly lies in the ventilating system. Referring to the matter, Mr. Rice, the chief engineer, states that he conducted a careful investigation on his own account and found that the excessive heat was due to the motors on the cars. He says:

"By putting your hand close to the motors on an express train when it reaches the terminal you at once will feel the heat they throw off. Indeed, a person can feel it as an express train rushes past a local station, by placing his hand close to the floor of the platform near the edge. It is like a procession of red-hot stoves rushing past."

The so-called "red-hot stoves" may be responsible for the excessive heat, but only because the ventilating system is at fault. The Rapid Transit Commission suggests installing small refrigerator plants at each station and an experimental plant of this nature will shortly be constructed, probably at the 96th street station.

Plants of this description in connection with electrically-operated exhaust fans may bring relief, but there are bound to be odors in the Subway, especially in summer, until the masonry has had an opportunity of becoming thoroughly dry.

* * *

Are Electric Waves the Cause of Primitive Life Forms?

The study of biology leads us down through various paths to the lowest type of life in existence. It even teaches us that a point is reached where a germ-like cell is all that is left to remind us of the organic architecture of which it forms an indispensable part. According to our most advanced ideas, the human form, as a purely physical entity, in common with all other types of life, is built up, cell upon cell, until the finished structure appears. The cells form aggregations or communities; and it seems to be the peculiar duty of each group to do a certain service for the organism as a whole. One collection of cells form bone, another the flesh, another one organ, another some other organ, until the great scheme is complete. But in spite of the extreme difference in the functions performed by certain kinds of cells they have a common duty to discharge. They hold within themselves that which is called vitality. They take unto themselves the particular elements necessary for their continued growth and existence. They fight great battles on our behalf. Their well being means good health; their injury through neglect, intention or accident means physical evil. They are influenced by the subtle requirements of a nervous system which is itself composed of microscopic cells. But through all cells there is at work a most mystifying, a most incomprehensible force. The cells add to each other, yet not so unduly as to present other than the normal appearance in one species or another. From the top of the ladder of life to the bottom we still find about the same cell. Originally, it was the only one postulating life. Where it came from, how it was developed, are the great questions of the hour.

Dr. J. H. Burke has recently performed some experiments with a test tube of sterilized bouillon exposed to the action of radium rays. He produced what are called radiophobes. They are in many respects identical with the lowest type of cells discoverable with the microscope. They are like living cells and yet unlike them. This is the sensational information imparted to us from abroad. It has given a new stimulus to the question, "Are electric waves related to the primitive life forms?" Are we to believe, in common with the biologists, that a primitive cell arose into being, in obedience to laws and influences of which we are today entirely ignorant. Life is not a chemical accident. It is not anything else but a link in the chain of manifestations. At a time when matter was exposed to the first conditions of creation a pathway was being made for it. Whether these first conditions of creation called into action ether disturbances or not is not the important point. The pivot of all argument rests upon the question asked by science—the question of the influence of certain waves upon organic matter. If Dr. Burke can answer according to the strict requirements of science, then the point of contact has been touched upon which connects an emanation from the most mysterious of known elements with our own world of life. Electricity, biology and physiology are about to meet on a common platform. We must be prepared for wonders both as regards results as well as statements.

* * *

Production of Mica in 1904.

Although mica has been found in commercial sizes in about one-third of the States and Territories, it has been mined during the past year only in North Carolina, New Hampshire, Colorado, New Mexico, California, Georgia, South Dakota and Idaho, which are named in the order of their importance as mica producers.

The total quantity of sheet or plate mica produced in this country during 1904, as computed by Dr. Joseph Hyde Pratt of the United States Geological Survey, was 668,358 pounds, valued at $109,462, an increase of 48,758 pounds in quantity but a decrease of $8,626 in value as compared with a production of 619,600 pounds, valued at $118,088, in 1903. It appears that in 1903 and 1904 the production was nearly 300,000 pounds greater than in 1901 and 1902. This large increase in the production of sheet mica during the last two years is due to the very large quantity of the small-sized disks and rectangular sheets of mica that have been prepared for electrical purposes.

The production of scrap mica during 1904 amounted to 1,096 short tons, valued at $10,854, as against 695 short tons, valued at $6,460 in 1903. During 1903, however, there were also reported 964 short tons, valued at $18,580, which were sold in the rough blocks as produced. This probably made at least 800 tons of scrap mica, so that the actual production of scrap mica in 1903 was greater than that in 1904. Of the 1904 production 610,121 pounds of sheet mica, valued at $100,724, and 200 short tons of scrap mica, valued at $2,000, were produced in North Carolina. This was over nine-tenths of the total production of the United States in 1904.

The imports of mica have, in late years, been several times greater than the home production. This is partly due to the fact that mica from Canada and India, which can be entered at a low valuation, has a tendency to curtail the production of mica in the United States. During 1904, 1,085,343 pounds of unmanufactured mica, valued at $241,051, and 61,986 pounds of cut or trimmed mica, valued at $22,663, were imported into the United States.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Mayor Dunne's idea of getting bids on 100 miles of city railway track has been blocked by the Chicago council. The Chicago Civic Federation has passed a resolution condemning municipal ownership.

A test of the first electric train on the Long Island Railroad showed that a maximum speed of 57 miles an hour was attained.

In an interview in the "Herald" Mr. Thomas A. Edison predicts that "radium is likely to be as cheap as coal one of these days." Discussing the wonders of radium Mr. Edison says: "Its effect on me was the most mysterious that I ever had occur. I found after a time that my eyesight was beginning to trouble me. That was the first symptom. I noticed that whenever I walked along the street and tried to read a sign a little ways off I would see double. After a while I found that every time I attempted to read it gave me a severe headache. This set me to worrying quite a little, as before I always had remarkably good eyesight. Mrs. Edison insisted that I was getting old and needed spectacles. Well, she might have been right about both statements. Anyway, I went to an occulist and had him examine my eyes. They stumped him. He puzzled over the case for a long time and finally confessed to me that he didn't know what was the matter. He said it was the most remarkable eye case that he had ever come across. One eye, he said, was perfectly normal and all right and the other about a foot out of focus. Besides the affliction radium has brought on me my assistant died about a year ago from its baneful effects. It first attacked him in the right hand. The surgeons were obliged to amputate it. Then they had to cut the limb off again at the elbow and still again at the shoulder. Then it attacked his left arm and that was amputated in two places. Then he died. Now when a mineral has such a subtle and untraceable effect as that it is a thing which should certainly be handled with the greatest caution."

Alexander Jay Wurts, Ph. B., M. E., E. E., of Pittsburg, Pa., has been appointed professor of applied electricity and head of the department of electrical practice in the Carnegie Technical Schools. Prof. Wurts will assist in the preparation of a curriculum and the equipping of the electrical laboratory for both night and day scholars in the school of applied science. The appointment takes effect September 1.

The yearly meeting of the American Street Railway Association will be held in Philadelphia in September. The convention will last a week. Messrs. W. C. Ely, of Buffalo, and John I. Beggs, of Milwaukee, were in Philadelphia recently making preparations for the meeting.

President Edgar, of the Edison Electric Illuminating Company of Boston, will soon sail for Europe to make a study of municipal ownership of electric lighting companies as practiced in foreign cities.

The accident to the New York Central's "flyer" at Mentor, O., last week, caused the death of three members of the Engineers' Club of this city—Mr. Wellman, Mr. Morgan and A. L. Rogers. Mr. Rogers was assistant to the president of the Platt Iron Works of this city and Dayton, O., and was well-known as an engineer. He was returning from a visit to the Dayton plant when he was killed. He was 40 years old and lived with his wife and one child at No. 10 Englewood Terrace, New Rochelle.

Annual Meeting of the American Institute of Electrical Engineers at Asheville.

About 200 members were present at the 22d general meeting of the American Institute of Engineers, held last week at Asheville, N. C.

President John W. Lieb, Jr., was the presiding officer, and after calling the first day's session to order introduced Mayor A. S. Barnard, who welcomed the delegates to Asheville by saying "that his city enjoyed new distinction as being the first to be visited in the South by the Institute." He said: "I esteem it a great privilege to meet the members of an organization that is doing so great a work. The South is rapidly developing, manufactures are spreading, and the Institute comes at an opportune time. The work of such organizations is fast obliterating those barriers imagined to exist between this and other sections of the country. The South has not been backward in adopting electrical methods. Asheville was one of the first cities to install an arc-lighting system."

President Lieb thanked the Mayor for his warm welcome and then delivered his annual address. He reviewed the work of the Institute for the past year and made many admirable suggestions for the administration of national engineering societies. He concluded his address as follows:

"It might be observed here that great care should be exercised in the conduct of a society occupied with a specific branch of engineering, that as far as practicable all of its divisions receive due consideration. In an Institute of Electrical Engineering, telegraph and telephone, electric traction and electric lighting, central station and isolated plant, transmission and distribution, design and construction, theory and practice, in fact all branches of electrical engineering, should receive consideration and in the solicitation of papers for the series of meetings held during the year a wide range of subjects should be covered so as to interest and attract the largest circle of members.

"The members at large should have a share in the benefits as well as the obligations of membership whether they be located near the headquarters of the society or at a distance. It is manifest that when the monthly meetings, as well as the more important annual functions, are held at the headquarters of the society, the members at a distance feel that they are at a disadvantage, and there is a tendency to form local clubs or organizations and secede from the parent society, or at least lose interest in it. The Institute has met this situation courageously and through the initiative of Past President Scott a series of local organizations was established and they have been added to under succeeding administrations; these organizations have done much to keep up the interest at distant points, and they have undoubtedly induced desirable accessions to the membership and have been an important stimulant of professional activity.

"Sister societies are facing the same problem and are watching the result of our undertaking—it can no longer be called an experiment—with great interest. But this scheme of local organizations while undoubtedly successful, is developing new problems and new conditions and requires the constant care and supervision of the central administration."

On motion of Mr. Calvin W. Rice the Secretary was directed to bring the address before the board of directors at the first September meeting.

The reading of the following papers was then called for by the President:

"High-Potential Oscillations of High Power in Large Power Distribution Systems," by Charles P. Steinmetz.

"An Experimental Study on Commercial Transmission Lines of the Rise of Potential Due to Static Disturbances Due to Switching, Grounding, etc.," by Percy H. Thomas.

Both papers were discussed by Messrs. H. G. Stott, P. N. Nunn, F. A. C. Perrine, S. M. Kintner, President Lieb and Dr. Samuel Sheldon.

Mr. P. N. Nunn, of Niagara Falls, held that generators, transformers and switching gear had now reached a state of great perfection and were more reliable than corresponding steam apparatus, but the transmission lines were not reliable and were lamentably far behind. No one knew the conditions obtaining on them exactly from moment to moment of the varying operations of the plant. When approached by capitalists to recommend very long transmission lines, he felt it better to be perfectly frank in stating that at present such work was to a great extent unreliable and experimental.

The next paper read was on "The Constant-Current Mercury Arc Rectifier," by Charles P. Steinmetz. The author said he had written the paper purely from an engineering standpoint and not on a metaphysical basis, and had found that he could treat the subject as a pure problem of the arc, without relation to theories.

The paper was discussed by president Lieb and Messrs. J. W. Howell, Dr. E. F. Northrup, P. H. Thomas and F. A. C. Perrine.

During the morning and evening sessions the following papers were read:

"Experimental Data Relating to Conductors and Underground Electric Cables," by Henry W. Fisher.

"Methods of High-Pressure Measurement," by S. M. Kintner.

"Some Comments on Remarks Made by Col. R. E. B. Crompton before the International Electrical Congress at St. Louis," by John W. Howell.

"The Preservation of Southern Streams —A Forest Problem," by C. E. Waddell.

"Three-Phase Traction," by F. N. Waterman.

"Heavy Electric Freight Traction," by C. De Muralt.

"Weight Distribution on Electric Locomotives, as Affected by Motor Suspension and Draw-Bar Pull," by S. T. Dodd.

"Choice of Motors in Steam and Electric Practice," by William McClellan.

"Electrical Features of Block Signaling," by L. H. Thullen.

"Limits of Injurious Sparking in Direct-Current Commutation," by Thorburn Reid.

"A Study in the Design of Induction Motors," by C. A. Adams.

"Limitations in Direct Current Machine Design," by Sebastian Sonstius.

"A New Instrument for Measuring Alternating Currents," by E.F. Northrup.

A brief discussion followed each paper as read. In the discussion on Mr. Howell's paper he claimed that tests showed that British lamps were found not to be equal to lamps of American manufacture.

The members and their friends enjoyed a number of trolley rides and the reception and ball was largely attended.

A banquet was given in the main dining room of the Battery Park Hotel. Mr. T. Commerford Martin acted as toastmaster. President Lieb and Mayor Barnard delivered felicitous speeches, and the following were the toasts:

"The Institute," Dr. S. S. Wheeler; "Theory and Practice," Dr. C. P. Steinmetz; "Technical Institutions," Dr. Samuel Sheldon; "Industrial Development of the South," Mr. John H. Finney, of the local committee; and "The Utilization of Natural Resources Through Electricity," Dr. F. A. C. Perrine.

The Railway Electric Power Company will use the Ganz system of three-phase, alternating-current electric traction.

ALTERNATING-CURRENT MOTORS IN INDUSTRIAL SERVICE.*

BY P. D. IONIDES.

The industries most generally requiring variable-speed motors having a wide range of speed are those connected with the making of paper, printing, dyeing and bleaching. In some cases the speed variation required is so wide and so gradual as to preclude the possibility of using induction motors, and until the recent development of the single-phase series motor there was no alternating-current apparatus which could meet these requirements. In the majority of cases, however, the requirements of speed variation can be met by the use of induction motors of either the squirrel-cage or slip-ring type. For paper calenders the usual requirements are (1) the dead slow speed for threading in the paper; (2) minimum speed for calendering certain classes of paper; (3) top speed for calendering other classes of paper.

These requirements can be met in the following manner: There is a small auxiliary motor driving the main motor through a worm gear and free wheel clutch, so as to give the required slow speed for threading in. The main motor is wound and connected to a controller of the tramway type, so that the coils of the stator can be grouped to form eight poles, at which the medium speed would be obtained, or four poles, at which the full speed would be obtained. In this particular apparatus the supply is at 25 cycles, and consequently the speeds of the motor are 360 and 720 revs. per min., making the usual allowance for slip. The changing from dead slow to half speed and from half speed to full speed is obtained by means of tappings from a pair of auto-transformers and a number of notches on the controller, whereby a gradual increase in voltage is applied to the motor as the controller is moved from notch to notch. This insures an even acceleration, and prevents any tearing of the paper. It would have been equally feasible to have wound the motor with 12 and 8 poles, so as to give three-quarter and full speed, or other combinations. The controller is placed remote from the motors for the convenience of the operator, and all movements are controlled by one handle. The whole apparatus is no more costly than direct-current apparatus to accomplish the same results would have been, and the operation is equally satisfactory.

A modified form of the arrangement just described for paper calenders can be used to great advantage on other classes of work; for example, in the driving of air compressors or hydraulic pumps. In this arrangement the motor is wound for two speeds—i. e., tappings are brought out from the windings so that the coils may be grouped to give full speed and half speed, or full speed and three-quarter speed, as the case may be, and connected to a double-throw switch, which when thrown in one direction will give the full speed, and in the other direction will give the half speed. This switch can be controlled either mechanically or electrically to regulate the speed of the motor to suit the demand. This arrangement is as simple, or even simpler, than any direct-current device to give corresponding changes in speed. A still simpler form of this speed-changing device can be used on squirrel-cage motors employed to drive machine tools and punching and shearing machines, where different speeds are required, and in this case the switch, which changes the grouping of the coils in the motor, is simply operated by hand. As an example—a 10 hp. motor used to drive a punching and shearing machine. For very heavy work the motor is required to operate at about 75 per cent. of the speed at which lighter work could be done. To meet this requirement, the tappings for the grouping of the coils should be so arranged as to give three-quarter or full speed. If half speed and full speed are required, the tappings could be arranged accordingly. The output of the motor is varied in direct proportion to the change in speed—i.e., a 100 hp. motor at 480 revs. per min. will give 75 hp. at 360 revs. per min. and 50 hp, at 240 revs. per min.; but the efficiency at any of these speeds is as high as it is possible to obtain within a very small percentage. As the power required to drive most machinery varies directly as the speed at which it is driven, the output of the motor corresponds very nicely with what is required of it.

The foregoing examples all deal with classes of work where certain fixed speeds will meet the requirements, and all that is necessary is the gradual acceleration between the fixed speeds, but there are other classes of work where it is necessary for the motors to have a speed variation of perhaps six or eight to one, with the possibility of being able to run continuously, and with high efficiency, at any intermediate speed. This requirement is principally found in connection with paper-making machinery, and in some cases with calico printing, bleaching and dyeing. The only electrical apparatus which can accomplish this result has, until recently, been the shunt-wound direct-current motor operating on two or more voltages, so as to give the required range of speed. The direct-current apparatus for this purpose has always been more or less expensive, and difficult to design. The single-phase series motor offers a method of accomplishing this result which is simpler and more efficient. For this purpose the apparatus will consist of a single-phase motor controlled by an induction regulator, which is a boosting transformer placed in series with the motor. This regulator or transformer raises or lowers the voltage, depending on the relative position of the primary, which is moved in relation to the secondary by means of a worm wheel and worm. Any required voltage from zero to full-line pressure can be applied to the motor, and consequently any required speed can be obtained. The losses in the induction regulators are simply the magnetization and C^2R losses. It will thus be seen that the arrangement is not only very efficient but provides for a range of speed variation in five shades which cannot be approached by any continuous-current device, unless it be very elaborate and costly. For variable-speed work, where contact stopping, reversing and starting again is required, both the squirrel-cage motor and the slip-ring motor may be used. With the former, the control is effected by applying different voltages to the primary by means of auto-transformers and a controller. For this service the resistance in the secondary should be increased so that the maximum torque is obtained at zero speed. This is accomplished by constructing the end rings, to which the bar windings are bolted, of metal having a higher resistance than that used in the construction of a constant-speed squirrel-cage motor. The torque of this motor varies as the square of the EMF. applied to the primary. This applies to the torque at all speeds—i.e. EMF. = 100 per cent., torque = 100 per cent.; EMF. = 90 per cent., torque equals 81 per cent.; EMF. = 80 per cent., torque = 64 per cent., and so on. By means of the auto-transformers and the controller, any voltage can be applied so as to give the required torque and speed. With the slip-ring motor, the control is effected by varying the resistances in the secondary circuit of the motor, and this method of control corresponds to inserting resistances in the armature circuit of a shunt-wound motor.

For overhead traveling-crane work, the squirrel-cage motor pessesses some advantages over the slip-ring type, in that three wires only need be led to each motor, and if three motors are used on the crane, one wire may be common to all three motors. Again, one set of auto-transformers can be used in conjunction with the three controllers for the control of the three motors, provided the capacity of these auto-transformers is equal to the maximum demand which will be made by the three motors. For operating winches, live rolls and work of this class, the slip-ring motor is preferable for the reason that, in the first place, the starting currents are not so heavy, and, in the second place, the currents handled by the controller are all in the secondary circuit, and consequently at a low pressure, which results in less burning of the contacts.

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*Abstract of a paper read before the Glasgow Local Section of the Institution of Electrical Engineers, May 23.

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ELECTRICITY LEAFLETS.

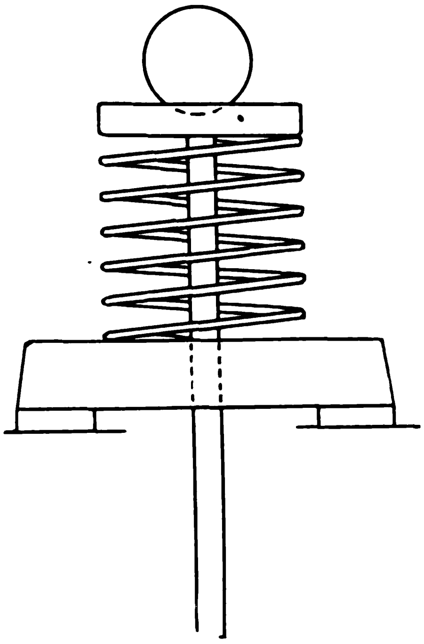
BY NEWTON HARRISON, E. E.

THE TRANSMISSION OF POWER.

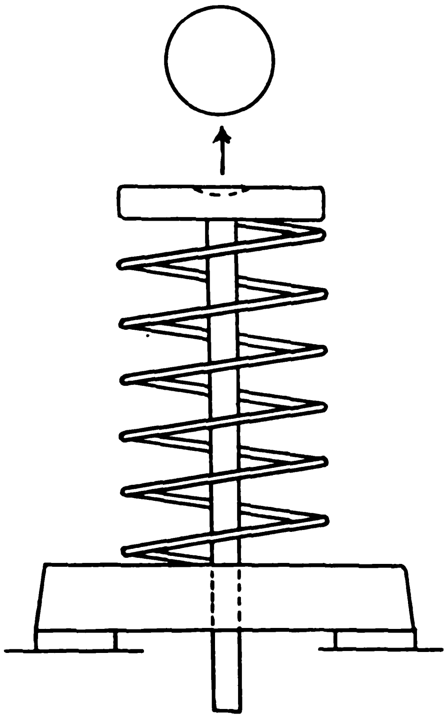
Definition of Power Transmission.—The phrase is self-explanatory, in that it refers to the *transmission* of power; the development of power at one point, and its delivery at another distant point. While the term power might be popularly considered with respect to this subject as a useful form of energy, it is evident that the new expression *energy*, equally metaphysical, takes its place. In order to clear away any misconceptions that may arise in connection with this subject, it is deemed advisable to give explicit definitions of the words, force, energy, work, power, machine, efficiency, etc.

Force Defined.—According to the Newtonian definition, force is that which moves or *tends* to move a body from a condition of rest to motion, or from a condition of motion to rest. There are two types of forces: those which act upon a body from without, and those which act upon a body from within. The first class are called external forces, the second class, molecular forces. Under either or both of these influences the phenomena of nature are produced in the organic as well as the inorganic world. Other expressions, such as muscular force, intellectual force, vital force, etc., relate to the force emanating from the muscles, developed by the brain or body as indicated.

Energy Defined.—Energy is defined as the power of doing work. A moving body which overcomes resistance displays energy. The amount of energy it displays depends upon its speed of motion or velocity and its weight. There are two kinds of energy—kinetic and potential. Kinetic energy is due to motion, potential energy to position. The latter is more generally interpreted as the power of doing work. When it is said that a thing possesses potentiality, a certain capacity or possibility is expressed. Potential energy resides in gunpowder or dynamite. It is the only form of energy possessed by a body high in the air at the instant before falling. In this case the potential energy is rapidly transformed into kinetic entirely through the influence of position. Water in an elevated reservoir presents the same case. The vapor of the clouds at the instant before condensation, or the liquid possibilities of the waterfall one instant before moving or falling, being merely an instance of potential energy, but instantaneously a striking illustration of developed kinetic energy. It must be remembered, however, that in the case of a falling body, at every point in its downward path, potential energy is undergoing transformation into kinetic. The cessation of potential energy is rapidly proceeding, that is to say, the kinetic energy is increasing in a falling body but the potential energy is diminishing. This represents a case of the energy due to position being transformed into the energy of motion. For this reason the reverse can be expected, the transformation of the energy of motion into that of position. This case appears in a body projected high into the air, the kinetic turns into potential energy; if permitted to fall it is retransformed again into kinetic.

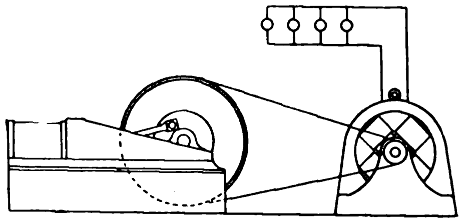


Potential energy of a spring.

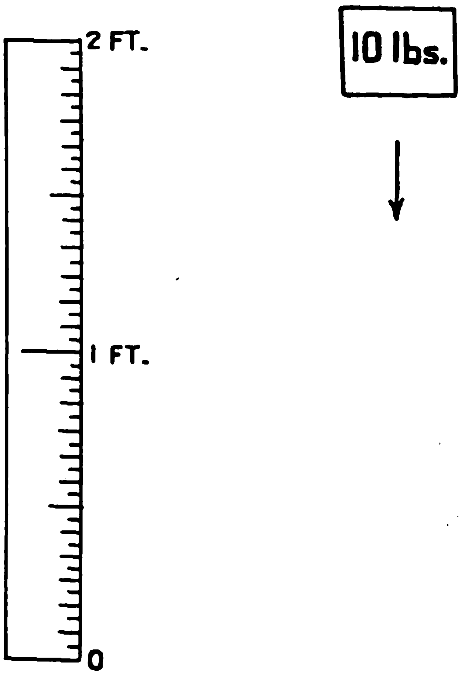


Kinetic energy of a spring.

Work Defined.—When motion is produced against a resistance work is done. The act of doing work is really the act of developing energy to accomplish a purpose. This idea presupposes some resisting influence. It may not be limited to visible results though the popular conception of the meaning of the word calls for such. In a mechanical sense, work means the employment of certain forces to perform certain operations. The tides, the wind, the power of steam, water, gas or electricity are utilized to

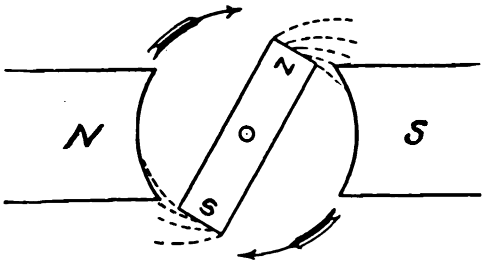


Work done by an engine.

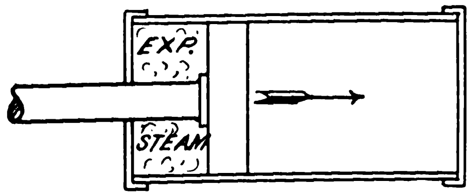


Twenty foot pounds developed.

do work. This work may consist of lifting, or moving plates along a horizontal plane. It may mean the application of forces to perform a service at a distant point. The measurement of work is made in foot pounds. A foot pound is the amount of work done in lifting 1 pound 1 foot against the force of gravity. According to the French system in which the kilogram, a weight of about 2.2 pounds is employed, and the meter, a distance of more than a yard, a kilogram meter is the unit.

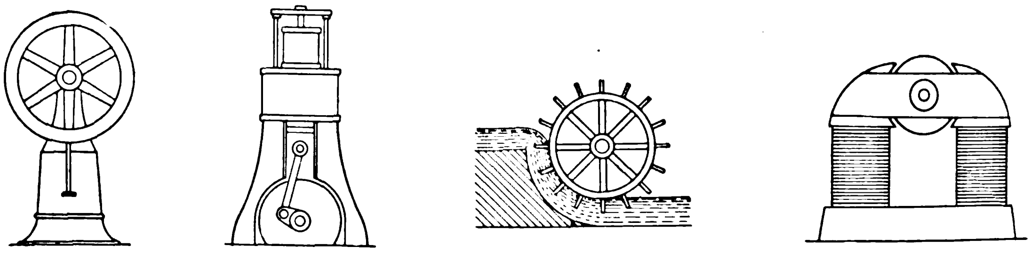


Magnetism producing motion and power.



Steam producing motion and power.

Power Defined.—The force applied to a machine is called the power. The expression power is also used in relation to the amount of work that is being done in a certain period of time. A horse power, for instance, is the rate of doing a given amount of work per minute or per second. It is given as equal to 33,000 foot pounds per minute. By this is meant that a weight of 1,000 pounds lifted 33 feet in a minute, requires 33,000 foot pounds to perform this effort. It also means that any rearrangement, such that the weight is greater or less, or the distance greater or less, which when multiplied give 33,000 foot pounds, represents a horse power. The element of time must be considered, otherwise the rate at which the power is being produced cannot be estimated. The time need not necessarily be a minute; it may be a second during which power may be used. In this sense, power may be rated according to its amount at any instant. An effort of a horse power may last only through a second, in which case one-sixtieth of the power is manifested. The 33,000 foot pounds a minute may be 550 foot pounds a second, or 55 foot pounds for a tenth of of a second, etc. The rate at which power is produced to do work, with respect to a given standard illustrates this idea. A steam engine, a gas engine or a motor are rated according to this basis. They are built to produce power at a certain rate per second or per minute. This determines their horse power and governs the statement made with respect to such an output. A motor, which is a machine in which electricity is transformed into mechanical energy is rated by the second, a steam engine by the minute. But if a 10 hp. motor or a 10 hp. engine are compared with each other, it will be found that each produces 330,000 foot pounds per minute or 5,500 foot pounds per second. The volts and amperes required for the electrical machine, and the quantity of steam and pressure required for the steam engine are simply different forms of power. In the first case, the electricity is transformed into magnetism through which a push and pull is developed in the motor, causing rotation. In the second case, steam is expanded in the cylinder of the engine, and while thus expanding, transmits its power to the piston which in turn rotates the flywheel. The results are the same though the means employed are different.


Gas Engine. Steam Engine. Water Wheel. Electric Motor.

Machines Developing Useful Mechanical Energy.

A Machine Defined.—If using explicit terms, a machine would be defined as a device by means of which force is able to produce an effect. It is to be understood, in the majority of cases, that the machine does useful work, though this is not necessarily required of it. The force applied to the machine is called the power. A distinction is made at times between a machine and a motor. In some instances a motor is regarded as the source of power, but in a purely mechanical sense. The power of this motor is the cause of motion. A motor, from this standpoint, may be the expansive force of steam, the effort of the muscles, the impact of the wind, or the explosive force of gas. Although the term motor is applied to a machine which transforms electricity into mechanical power, it is easy to understand that its most authoritative use would be made when the expression is applied to the electricity itself. Adopting the common phraseology, however, with its accompanying meaning, the word motor is applied to any machine which transforms energy into mechanical motion. The broad application of the word energy is here made, according to the most advanced ideas of physicists. Electricity is a form of energy; steam or gas another phase of its existence. The machines through which electricity, steam or gas can be transformed, so that their respective powers can be utilized, are very different from each other. They represent, as it were, a channel through which their agencies can operate. The agencies differ, but their mechanical results are alike. If, in operating through a machine, one form of energy is more readily convertible in mechanical motion, or into the other form of energy required than another, it is said that a higher efficiency results.

Efficiency Defined.—The engineer deals with the problem of efficiency from a commercial as well as a scientific standpoint. The commercial considerations involved are such that it does not pay to gain a high efficiency at too great an expense in construction. The scientific considerations involved are such that it is useless to experiment unless there is an absolute reason for seeking more advantages. The laws of nature on the one hand, and the influences governing supply and demand on the other hand, exercise control. Efficiency in a device is expressed by the ratio between the power taken out and the power sent in. For instance, if an electric motor develops 8 hp. and an amount of electrical energy equal to 10 hp. is sent in the efficiency would be the ratio of 8 to 10 or $\frac{8}{10}$, equal to 80 per cent. If other intermediate devices lie in the path of the incoming energy, they must be considered in connection with the machine receiving the power. In other words, the net result in energy obtained, must be compared with the sum of the energy applied, in order to institute a relationship called efficiency. In power transmission, the efficiency is the most prominent feature under consideration. A choice of power transmission methods is guided entirely by the efficiency in prospect, and the cost due to such an installation.

Methods of Transmitting Power.—Although modern science and engineering have demonstrated that the electrical transmission of energy is by far the most efficient method in existence, it must be remembered that other methods have been tried very extensively with varying degrees of success. Power can be transmitted by means of steam, compressed air, water, wire rope or electricity. It can be transmitted in some other forms as well, but they cannot receive consideration on account of their impracticability. In Manhattan Borough of Greater New York, steam pipes extend over a distance of several miles, from one end of the city to the upper section. The steam is used for heating or for power as required. It may be stated that its utilization of power is very limited in comparison with its use for heating. In this respect, the manner in which the power is distributed along the route is indicative of the fundamental difference between the transmission and the distribution of power. The same practice would be carried out in the case of pipes carrying compressed air. In Paris a system of this kind met with general success for a while. It is not employed for the transmission of power between points widely apart. It really represents a case of the distribution of power, and over short areas is used quite extensively. In mining, compressed air is of great service because of the supply of pure air a method of this kind guarantees. In private homes it would also find a place. Cool fresh air in hot weather would find a ready sale if directed into rooms escaping the influence of brisk circulation. In the same sense water under pressure could be readily converted into power by means of small water wheels. It has been employed for this purpose in the past. It is not a very good method where distances are great between the points of application of the power and the generation. Wire rope transmission belongs to a category all by itself, yet it only emphasizes the principle of conveying power from point to point by means of a medium possessing a great inertia, weight, friction, etc., in comparison with one entirely different in character. A wire rope moving over a distance of several miles cannot be very efficient. The friction, inertia, weight and repairs are naturally great. It has been estimated that the comparatively recent cable systems in New York and Chicago barely reached the figure of 20 per cent. efficiency. Out of every 1,000 hp. developed only 200 proved effective. The same sized copper conductor as that employed as a steel wire rope in cable service would transmit more than 50 times as much power in the form of electricity. Wire rope transmission is highly inefficient over comparatively short distances. Over long distances, such as 10 miles, the wire rope, compressed air, water or steam methods of power transmission would prove commercial failures.

Character of the Electric Power Transmitted.—There are two kinds of currents which may be transmitted over long distances. One is called direct and the other alternating. The transmission of a high tension *direct current* is attended with difficulties which are almost insuperable objections to its use. The alternating current in a modified form seems to be particularly adaptable to long distance power transmission. The character of the electric power transmitted is thus the solution of the problem, if due consideration is given to the machines necessary to make such an enterprise a success. The reasons why direct current cannot be employed are first insulation, second transformation, and third cost of installation. They might be summed up in the phrase, insulation, transformation and installation. On the other hand, where an alternating current is employed for long distance transmission the insulation problem is readily met in the transformers employed. There is no necessity for revolving parts developing a high potential. Transformation from a high to a low potential or vice versa, or from alternating to direct, is readily and in many respects cheaply as well as efficiently accomplished. The cost of installation is much less with alternating current generators than with direct.

The alternating current employed for long distance power transmission is not the ordinary single-phase current, but a two or a three-phase current. A two or three-phase current is employed because it makes an appropriately constructed motor self-starting. This fact is of importance in the further transformation at the end of the power circuit of alternating into a direct current.

THE CHOICE OF AN INSULATED CABLE.*

BY WALLACE S. CLARK.

(*Concluded from page 355.*)

This saves in first cost, in cost of installation, and in cost of ducts. If a number of small leaded cables are run in one duct, which is necessary in order to keep the duct investment reasonable for the arc circuits, one cable burning out in a duct is very likely to injure the others. Further, the cables are liable to mutual injury when being installed, and it is quite difficult to draw out one cable without damaging the others. These are defects that may be avoided if a multiple-conductor cable is used.

Single-phase two-wire lines not exceeding No. 0000 size should be run as twin conductors unless numerous taps are made, in which case the greater convenience in making joints may justify the use of the single-conductor cable. The concentric type of cable for single-phase work is losing favor in England and on the Continent and has never been in favor in this country. The most serious objection is that in a large network of concentric cable on single-phase or three-phase alternating circuits, great care is required in switching, since the outer conductor has a very much higher electrostatic capacity to earth than the inner conductor, giving rise to surging of the voltage and current and to burn-outs. For three-phase work, three-conductor cables, and for two-phase (quarter-phase) four-conductor cables are required, both on economic and engineering grounds.

Types of Insulating Material for Different services: (a) Station Wiring.—I believe the majority of engineers who have had experience in central-station construction now consider that cables without metallic sheaths are better than leaded or other metal-sheath cables for this class of work. The lead sheaths are generally grounded, and must be grounded in a high tension system to prevent the accumulation of static charge. These grounded lead sheaths offer the arc from any conductor to earth in their neighborhood a ready inducement to spread and cause trouble on adjoining cables. The lead sheath on circuits exceeding 5,000 volts, and on all voltages if the cable is paper or fibrous insulation, must terminate in an end bell or pothead to prevent the breakdown of the cable at the terminus of the lead sheath. This end bell in addition serves as a seal to prevent the absorption of moisture in the case of paper or similar cable.

Cables for tensions not exceeding 750 volts that can be run in dry non-metallic ducts without pockets where water may collect, or on suitable incombustible insulators—porcelain, glass, slate shelves, concrete, etc.—require insulation only to prevent shocks to operatives and short-circuits due to mechanical causes, such as a workman dropping a wrench or bar across two bare conductors. An excellent type of cable for this work is one insulated with varnished cambric tapes and asbestos (asbestos being on the outside), finished with a flame-proof braid. Such a cable can be operated continuously at the boiling point of water without injury. The varnished cambric, being inclosed in asbestos, does not introduce any additional fire risk, as do weatherproof or rubber cables. The rate of deterioration is less than with other types and the cost low. The first use of this type on a large scale was in the Harrison street station of the Chicago Edison Company in 1893. Since then they have been largely used in station practice and have never given any trouble; they have in one or two cases come through fires practically uninjured.

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*Paper read before the National Electric Light Association at its 28th convention, held at Denver-Colorado-Springs, Col., June 6-11, 1905.

For pressures of 1,000 volts and upward we must use rubber cables of good quality, or some satisfactory substitute. Such cables, unless protected by individual fireproof runways, should be protected on the outside by an asbestos jacket. This jacket will prevent fire following along the cable or bunch of cables; it also acts as a protection, to a considerable extent, from the destructive action of an arc from an adjoining conductor.

If rubber insulation is used it should be of good quality, and such cables cannot be cheaply made owing to the present extremely high price of the better grades of crude material. Rubber cables should not be operated at temperatures exceeding 125 degs. F. if reasonable long life is expected of the insulation. Lower operating temperatures are most desirable, as they will do much to prolong the life of the insulating wall. Higher temperatures cause very rapid deterioration of the insulation. In England, and to a less extent on the Continent, various patented compounds, made usually from oils and bitumens, have been tried, and with fair success, on low-tension work, and where they were not subjected to any high degree of heat. These cables are not adapted to the high temperatures that prevail during summer in most stations, nor will they give satisfaction when run at the high-current densities common in this country. The best that can be said of these insulations is that they are more or less successful imitations of vulanized rubber and generally have all the faults of rubber insulation more or less exaggerated.

You are all no doubt familiar with the large use of oil varnish films in the insulation of electrical apparatus such as transformers, generators, motors, etc., usually used in combination with some woven fabric to give mechanical support to the film. Six years ago, after extended experience with this type of insulation, the company with which I am connected became convinced of the value of the insulation for cable work, especially on cables of large size or for very high voltages. The insulation developed consists briefly of cloth tapes especially treated and coated on both sides with multiple films of varnish. These tapes are applied to the cable and between the tapes is a thin film of plastic insulating material which does not dry or become hard. The function of this plastic layer is to increase the flexibility of the cable by allowing the tapes to slide one upon another when the cable is bent. Cables thus insulated are tested and finished the same as rubber-insulated cables with braid, lead or any other desirable finish.

This type of insulation has all the good qualities of paper cables. It will withstand as high temperatures; it is more flexible; has a considerably higher dielectric strength; and finally, most important of all, does not absorb moisture and can be used in interior work without a lead jacket. The varnish and cambric insulation, which I will speak of as V. C. for the sake of brevity, will not decentralize or deteriorate under temperatures destructive to rubber insulation. Mineral oil will not rot it. So far as data are obtainable, its rate of deterioration is less than that of vulcanized rubber of the best quality under like conditions. Its dielectric strength is fully equal to that of rubber insulation. The method of manufacture is one insuring a homogeneous insulation of uniform dielectric strength—a point extremely difficult of attainment in rubber-insulated cables for high voltages. This type of insulation, I believe, is especially suitable for station wiring in the higher potentials and larger sizes of cables. It lacks only one quality to make it approach very near the ideal—it is not in itself fireproof, neither is rubber nor paper. Like rubber-insulated conductors, it may be flame-proofed with asbestos on the outside, or, in fact, with any available material that can be used over the other insulations. It has not as yet been applied to very small conductors for potentials below 1,000 volts; for these, rubber is at present the best available insulation. For small conductors for high tension an inner wall of rubber and an outer wall of varnished cambric makes an extremely effective cable and one much cheaper than cable built entirely of rubber.

Passing to conductors outside of the stations, these may be roughly divided into transmission lines, practically always operated at potentials of 4,000 volts or more and running to sub-stations. The second class of cables comprises the distributing systems with feeders seldom exceeding 3,000 volts and mains to which customers are directly connected operating at 500 volts or less. Circuits outside of the station using insulated cables are practically all underground. There are a few cases where high-tension leaded cables are run on pole lines supported by a steam cable similar to telephone practice, but this may be regarded as a temporary expedient.

Underground construction in this country consists almost entirely of lead-jacketed cables in conduits, the most permanent type of duct being thoroughly vitrified tile. For installations where electrolysis can be guarded against, or is not to be feared, paper-insulated lead cables give thoroughly satisfactory service when carefully installed. Where severe electrolysis is counted on or where the ducts are filled with water for considerable lengths of time varnished cambric or rubber leaded cables should be used to insure against interruptions of service.

There are some successful installations of rubber cables, not lead-sheathed, in operation. It is, however, questionable if this is the best practice, since the ultimate life of the leaded cables will, I believe, be sufficiently extended to warrant the extra cost of the lead jacket.

Services to customers are installed in short lengths, although amounting to a considerable proportion of the cost of an underground system, and are most convenient when insulated with a material not requiring special sealing of the ends to protect against the absorption of moisture, and it is a common practice to use rubber-insulated cables for this purpose. I believe varnished cambric to be equally well suited to the requirements.

Where sub-aqueous lines are called for various constructions are possible. With narrow, shallow streams or canals the line of conduits may be dropped with deep manholes and the ducts carried underneath the bed of the stream. This usually necessitates draining the ducts toward one manhole and providing a small pump to keep the manhole clear of water seeping in. Wide, shallow streams can have a trench dredged or dug across them and cables with band steel armor laid in the trench which will usually be rapidly filled with silt. For deeper streams or wider streams armored submarine cable is required. A method used with success in some cases is to lay a cast-iron water main with specially bolted ball and socket joints along the bottom of the river and to draw an unarmored leaded cable through it. Tunnels can, of course, be used, but except for a very heavy line containing a number of cables this construction is extremely expensive, and it is cheaper to install one or more spare cables which can be switched into service in case of accident to one of the operating cables. It is perhaps well to mention here that where a submarine cable or underground cable is inserted in a pole line of any length adequate lightning protection should exist at each end of the cable.

There are many cross streets where only a distributing main of, say, three 0000 conductors is required. A single duct with small manholes every 75 feet for service distribution will cost at least 50 cents per duct foot, including service manholes and omitting all paving charges. Single .0000 cables suitable for this use can be armored for approximately 8 cents per foot, or 24 cents for three cables, showing a direct saving of 16 cents per foot of three-wire main, allowing 10 cents for trenching. If smaller sizes of conductor were used in the comparison the saving of the armored cable over the duct would be largely increased, since the duct charge is fixed, while the cost of armoring is approximately proportional to the size of the cable. With such constructions services can be installed at any point, the joint being protected by cast-iron T boxes. Such cables are usually installed inside of the curb lines, saving the expense of disturbing expensive pavement. Cables thus installed can run into manholes belonging to the conduit system at either end of the block and be then worked in with the regular distributing system. For service to buildings set back from the street, for an underground system connecting a group of buildings of a permanent character such as a college with fine grounds, where overhead lines are an eyesore, and for complete systems in small cities where the conduit system is too expensive, this type of cable represents a neglected opportunity, I believe, to American engineers.

PROPER REQUIREMENTS AS TO TEST PRESSURES.

Before it is shipped from the maker's factory every cable should be tested with an EMF. higher than the maximum working pressure. If possible, a similar test should be made after the cable is installed and jointed. As to the relation which these test pressures should bear to the working pressure, the duration of the tests, etc., there exists considerable diversity of opinion. For a good many years the writer has advocated two and one-half times the working pressure for 30 minutes to an hour as a factory test and twice the working pressure for the same length of time after the cable is installed. Cables tested under these requirements have given no indication in practice that the margin of safety was not ample. Some engineers, desiring a higher factor of safety on important and large installations, specify a factory test of three times the working pressure and a test installed of two and one-half times. Any requirement more severe than this represents a questionable investment on the part of the purchaser. It is especially undesirable to make very high potential tests for very short periods of time, since the cable may be decidedly weakened by such treatment, although it does withstand the high-potential test for the brief period specified. In short, the words "breakdown test" should not appear in cable specifications, in the writer's opinion. Boilers are tested to see if they are safe for a given working pressure, but such test is not usually referred to as a bursting test. Cable tests should be considered on the same basis. They are not to show the ultimate strength of the cable but to show that the cable is safe and satisfactory cable for the purpose for which it is intended.

WRINKLES.*

EDITED BY H. C. ABELL.

Balancing a Circuit by Grounding the Neutral.

We have on our direct-current, 220 to 440-volt three-wire system, a 75 hp. 220-volt motor, which runs from midnight to 6 o'clock A. M. This greatly unbalances the load, and as the motor is a mile and a half from the station the drop in the neutral was at first considerable. By means of switches at each end, the neutral is now grounded while the motor is running, the other wire being of sufficient cross-section to carry the current. This has completely overcome the difficulty and no more trouble has been experienced.

H. S. RUSSELL, Denver, Col.

Protecting Apparatus from Water in Case of Fire.

The installation of sub-stations in the basements of commercial buildings that are not classed as fireproof buildings makes it imperative that some protection be given the apparatus installed against flooding by water in case of fire.

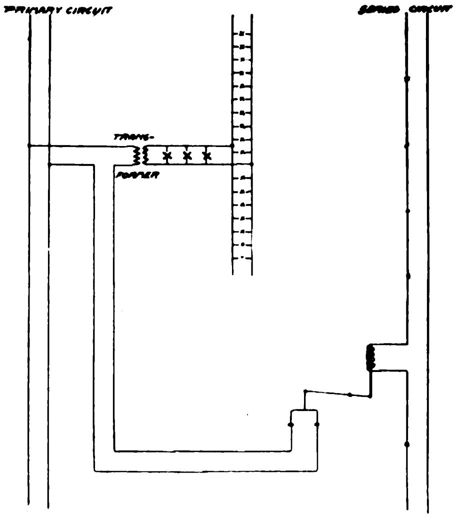
In a sub-station recently installed under such conditions a 12-inch pipe was installed in the floor and connected with the service. It is supplied with a valve for normally keeping the pipe closed, but which is be opened by the operator in case of fire, and as the apparatus is on foundations raised above the floor level, with a water-tight floor overhead, little if any flooding will be possible that this pipe will not care for.

EDISON ELECTRIC ILLUMINATING CO.,
Boston, Mass.

An Automatic Switch for Controlling Constant-Potential Lights from a Constant-Current or Street-Lighting Circuit.

This consists of a pair of arc-lamp magnets with suitable contacts mounted on a wooden frame and placed in an old 1,000-watt transformer case.

The illustration shows switch used to control eighteen 25 cp. incandescent street lamps from a 7.5-ampere series arc circuit. The nearest series incandescent circuit was 3½ miles away and it would not pay to extend the line for 18 lamps.



DIAGRAM

They were at first turned on and off by hand, but after being out all night and burning all day a few times this method was found unsatisfactory, and the automatic switch was designed to start and stop the lights when the arc lamps were put on or taken off.

J. T. COWLING,
Mt. Vernon, N. Y.

Method of Installing Bell and Push Button on Old System.

Several months ago I was called to our leading hotel to install a bell and push button between two rooms. The party was confined to his bed and wished to call his nurse from the other room.

The hotel was wired on the return call system; we had no bells or batteries in stock, and the job was urgent. After looking over the layout I opened the bell connection on one side, connected lamp cord in series with bell, inserted push button in other end of lamp cord, which I made long enough to reach to patient's bedside. I then had bell and push in series. To get the battery I short-circuited push button at office annunciator three floors below. It worked all right.

FRED B. SHARPE, Liberty, N. Y.

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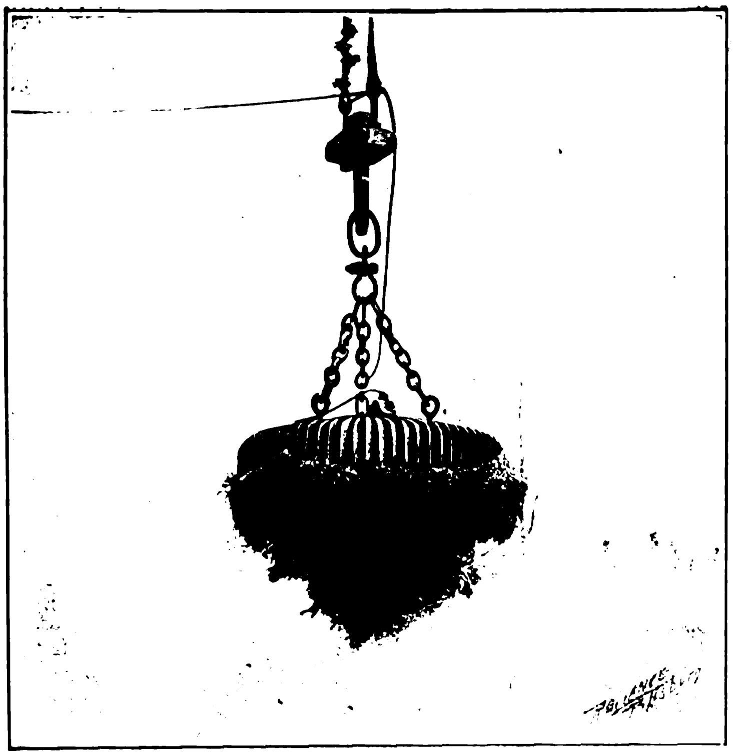
*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

LIFTING MAGNETS.

The idea of utilizing magnetic force for lifting purposes is not new, but it is only comparatively recently that the apparatus and mechanism has been perfected.

The Electric Controller & Supply Company of Cleveland has devoted much time to testing and perfecting various forms and types of magnets for handling iron and steel, such as light and heavy melting scrap, steel ingots, blooms, billets, etc., which has resulted in electric magnets being extensively adopted by various concerns engaged in the iron and steel industry.



Magnet Handling Machine Borings.

It may not be generally known that a single design of magnet is not adapted to handling the full range of material above mentioned; on the contrary the magnet must be designed to suit the class of metal to be lifted. A magnet, for instance, which would handle five tons in the form of an ingot, might not lift over 600 pounds in the form of thin plates. In other words, the magnet has to be designed with a general view to the work it is expected to perform.

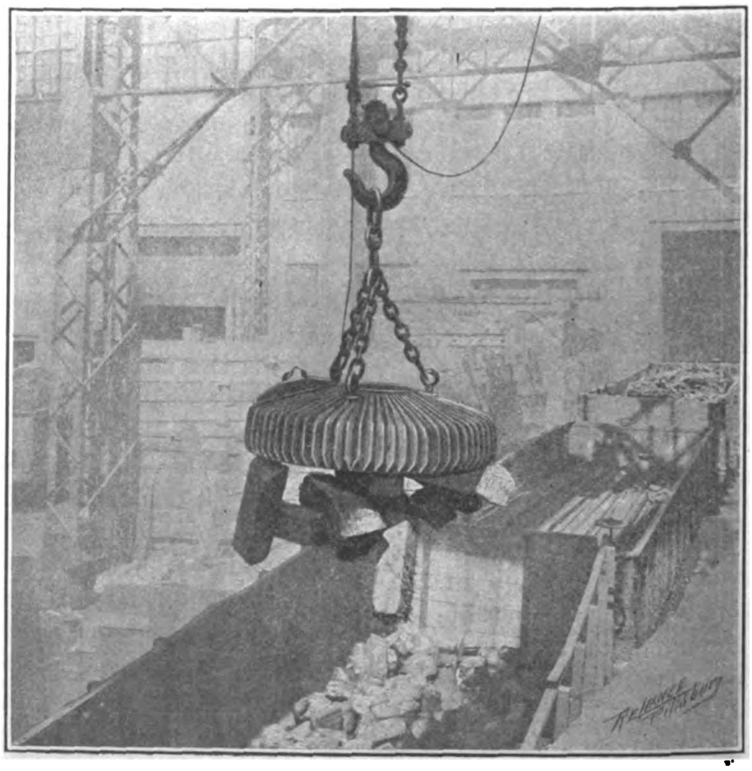
Magnet Handling Rail Ends.

Experience has proven that the advantages of the electric magnet over other forms of lifting machinery are saving in time, saving in labor and a saving in storage space. That they do their work well may be inferred from the fact that in practical trials electric magnets have lifted as much as 11,000 pounds and could undoubtedly be designed to lift even heavier loads. As an illustration, however, of the capacity of an ordinary electric magnet in every-day work, assuming the average lift to be 1,000 pounds, and that the work is to consist of loading from cars into furnace charging boxes; also that the crane man can make a transfer in 45 seconds, or 90 per hour, and that the crane works 11 hours in each 12-hour turn, a crane using such a magnet will have a loading capacity of 1,000 × 90 × 11 ÷ 2,000 = 494 tons per turn.

One five-ton crane is generally provided for every three fifty-ton furnaces in an open-hearth plant, and three such furnaces would require about 225 tons of stock per 12-hour turn.

It is evident, therefore, that with such a magnet a five-ton crane could serve four such furnaces with ample margin of safety, thus increasing the capacity of the crane besides saving the wages of the labor ordinarily used for filling the boxes.

There are two general methods of wiring electric magnets used for lifting. Of course, a controller must be mounted in the crane cab. A drum is then mounted on the trolley and geared to a hoist shaft. A twin conductor flexible cable conveys the current to and from the magnet, the drum taking care of the slack. The cable is connected to a pair of contact rings on the drum and the current is conveyed from the controller in the cab to the drum through an extra trolley wire and returned through the common return trolley wire. In the second method the twin conductor cable goes up through a pulley block attached



Magnet at Work Handling Heavy Crop Ends.

to the crane trolley; back to a block attached to the girder near the cab; down through an idle block, and back through the second block to the switch or controller in the cab. A weight is attached to the idle block which rises and falls to take care of the slack cable required.

Fast Electric Traction.

(From the London Post.)

At present public interest in Germany is concentrated on the possibility of high-speed electric traction between Berlin and Hamburg, which, if a new straight line were built, would be 155 miles distant by rail. During the discussion of the high-speed experimental line , Messrs. Siemens & Halske proposed a single-track electric line at a cost of $17,500,000, on which trains would run the whole distance either way, with a stop half way, in five minutes under two hours. The General Electric Company proposes a double line, on which trains would travel 100 miles an hour and do the journey in 1 hour 25 minutes, for $32,500,000. For $37,500,000 they believe they could raise the speed to 125 miles an hour.

The Steam Turbine Controversy.

The Edison Electric Illuminating Company, of Boston, has been running two 5,000 kw. Curtis turbines for a year, and their operation has been so successful that the company has ordered the third installation of a 5,000 kw. Curtis turbine.

A leading official of the Edison Company says: "There seems to be considerable discussion in the press as to the merits of the Parsons and Curtis turbines, the former controlled by the Westinghouse Company and the latter by the General Electric Company. Both are good machines, but the General Electric Company has already sold three Curtis turbines to one Parsons in this country and the Curtis machine is by far the younger machine. I understand that the General Electric Company has sold 300 Curtis turbines and has delivered 190."

Canadian Electrical Association Convention.

Nearly 300 members were in attendance at the 15th annual convention of the Canadian Electrical Association, held last week at Montreal. The programme, as published in last week's ELECTRICITY, was carried out in every detail. The following papers were read:

"Effects of Frequency and Voltage on Transformers," by Mr. M. A. Sammett; "Transformers," by Mr. R. T. McKeen; "Selection and Maintenance of Service Meters," by Mr. William Bradshaw; "Incandescent Lamps," by Mr. A. B. Lambe; "The Operation of Alternators in Parallel," by Mr. A. L. Mudge; "Induction Motors," by Mr. H. A. Burson; "Heating of Inclosed Inductors," by Prof. R. B. Owens;. Economy of Isolated Plants," by Mr. K. L. Atkin; "Notes on Steam Engines and Boilers," by Mr. William McKay.

New York Electrical Society's Annual Meeting.

At the 24th annual meeting of the New York Electrical Society it was announced that the finances and membership list of the society were in a sound condition, and Secretary Guy's report showed that 46 members had been elected during the season; the loss by death had been 4, by resignation, 25; ten had been dropped and the total existing membership was 636. The report of the treasurer showed a steady improvement in the finances of the society. The officers elected were:

President—W. S. Barstow.

Vice-presidents—H. G. Stott, Putnam A. Bates, Max Loewenthal.

The vice-presidents elected in 1904 for two years are Albert F. Ganz, Louis B. Marks, W. S. Rugg.

Secretary—George H. Guy.

Treasurer—H. A. Sinclair.

Electric Process of Smelting Ores.

The Dominion Government has appropriated $15,000 for the purpose of making experiments with tho electric process of smelting ores and manufacturing steels. The experiments will take place at the plant of the Consolidated Lake Superior Company at Ottawa, which concern will supply 400 hp. for four months without charge.

Soldering Paste.

As every one in the trade is aware there are numerous makes of solder or soldering paste on the market. Soldering paste plays a very important part in many lines of industry and frequently very much depends on its holding or binding qualities. In view of this fact it is only natural that the best soldering paste should be sought for especially in the electrical industry, where so much depends in the way of electrical resistance on a joint.

From tests that have been made, as well as from practical experience, the soldering paste manufactured by the Chicago Solder Company, 46 North Union street, Chicago, would seem to meet every requirement. Persons interested may obtain full information on the subject by addressing the above concern.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JUNE 20, 1905.

Electric Railways and Appliances.

792,689. Circuit-Closer for Trolley-Signals. Harold E. Bradley, Warwick, R. I. Filed Oct. 19, 1904.

792,818. Railway Signaling System. Ezra R. Fern, Scranton, Pa., assignor of one-third to John W. Barnes, same place. Filed Sept. 6, 1904.

792,903. Trolley-Stand. Frank N. Kelsey, New Haven, Conn., assignor of one-half to Cornelius Conway, Jr., same place. Filed April 14, 1905.

792,919-920. Car-Fender. John O'Leary, Cohoes, N. Y. Filed Nov. 7, 1904, and Feb. 28, 1905.

792,959. Clamp for Trolley-Wires. Chris C. Bakewell, Kaylor, Pa., assignor of one-half to T. W. Minford, same place. Filed March 31, 1905.

792,963. Railroad-Signal. Albert M. Bullard, Somerville, Mass., assignor to the American Signal Company. Filed May 8, 1903.

Electric Lights and Appliances.

792,738. Electric Cigar or Lamp Lighter. Frank W. Smith and William H. Smith, New York City. Filed Aug. 1, 1902, Renewed Jan. 9, 1905.

792,756, Illuminated Sign. Hjalmar Christensen, Seattle, Wash., assignor of one-half to Aral Gustavus Walin, same place. Filed Nov. 28, 1904.

Electrical Machinery and Apparatus.

792,684. Electric Motor. Thomas S. Watson, Milwaukee, Wis. Filed March 21, 1905.

792,734. Automatic Electric Switch. Herman A. Schultz, Berkeley, Cal. Filed Jan. 3, 1905.

792,748-749. Power-Transmitting Mechanism. Bion J. Arnold, Chicago, Ill. Filed Jan. 31 and Feb. 19, 1900.

792,762. Dynamo-Electric Machine. Gano S. Dunn, East Orange, N. J., assignor to the Crocker-Wheeler Company, Ampere, N. J. Filed Oct. 24, 1904.

792,787. Electric Unloader for Air-Compressors. William Prellwitz, Easton, Pa., assignor to the Ingersoll-Sergeant Drill Company, New York City. Filed Nov. 20, 1903.

792,845. Electrical Switch. Hubert Pfirmann, Frankfort-on-the-Main, Germany. Filed Aug. 20 1902.

792,859-860. Electromagnetic-Switch. August Sundh and David L. Lindquist, Yonkers, N. Y. Filed Oct. 27, 1904.

792,875. Block-Signaling Mechanism. Charles P. Bass, Portland, Ore. Filed March 7, 1904.

792,974. Countershaft Attachment for Electric Motors. Edwin R. Douglas, East Orange, N. J., assignor to the Crocker-Wheeler Company Ampere, N. J. Filed Oct. 17, 1904.

793,035. Electric Meter. Isidor Kitsee, Philadelphia, Pa. Filed Nov. 17, 1902.

Telephones and Telephone Apparatus

792,601. Sanitary Attachment for Speaking-Tubes or Telephone-Mouthpieces. Walter S. Little, Lynn, Mass. Filed March 3, 1905.

792,691-693. Telephony. Edward A. Buell, Dekalb, Ill., assignor to the Selective Signal & Telephone Manufacturing Company, Sycamore, Ill. Filed May 9 and Oct. 25, 1904.

792,927. Telephone-Transmitter. De Elbert A. Reynolds, New York City. Filed Feb. 25, 1905.

Miscellaneous.

792,597. Electrolytic Cell. John F. Kelly, Pittsfield, Mass., assignor to the Southwestern Exploration Company, Alamagordo, N. Mex, Filed Sept. 9, 1904.

792,611-613. Battery Grid. Henry C. Porter, Waukegan, Ill., assignor to the Evansville Battery & Electric Company, Evansville, Ind. Filed Aug. 19, 1904.

792,612. Battery-Plate Separator. Henry C. Porter, Waukegan, Ill., assignor to the Evansville Battery & Electric Company, Evansville, Ind. Filed Aug. 19, 1904.

792,639. Vapor Electric Apparatus. Willis R. Whitney, Boston, Mass., assignor to the General Electric Company, Filed Dec. 19, 1903.

792,776. Magnetic Separator. Elwin C. Kavanaugh, Holyoke, Mass. Filed April 15, 1904.

792,855. Electric System. Axel L. Sjoberg, Union Hill, N. J. Filed Sept. 23, 1904.

792,892. System and Means for Laying Electrical Wires in Conduits. Guy M. Gest, Cincinnati, O. Filed Feb. 14, 1903.

793,033. Electric Circuit. Isidor Kitsee, Philadelphia, Pa. Filed Aug. 16, 1901. Renewed Oct. 16, 1903.

793,036. Electric Clock. Isidor Kitsee, Philadelphia Pa. Filed Nov. 17, 1902.

793,037. Electric Telegraphy. Isidor Kitsee, Philadelphia, Pa. Filed Feb. 4, 1905.

793,039. Process of Treating the Metal Mixtures Produced as a By-Product in Electrolytic Metal-Refining. Anson G. Betts, Troy, N. Y. Filed May 20 1904.

THE TELEPHONE WORLD.

Proceedings of the Interstate Independent Telephone Convention at Chicago—Tragic Death of Mr. S. P. Sheerin While Responding to the Address of Welcome.

The annual convention of the Interstate Independent Telephone Association at Chicago last week was well attended, but the first day's session was cut short by the sudden death of Mr. S. P. Sheerin.

The convention had met in the hall on the sixth floor of the Auditorium at 10 o'clock for the first business session. Mayor Dunne was scheduled to give the welcoming address, but, unable to be present, he was represented by Public Prosecutor Howard S. Taylor.

Mr. Sheerin was selected by the executive committee as the man to answer the welcome of Mayor Dunne as given by Mr. Taylor.

The address of Mr. Sheerin, which he had only partly completed when he was stricken, is as follows:

"On behalf of the delegates present and the 2,500,000 telephone users in the United States whom we have the honor to represent, I thank you most sincerely for this cordial welcome to Chicago. I may now be in answering Mayor Dunne's welcome, addressing one of Chicago's future mayors. At least I hope so."

At this point the speaker's face blanched and turning to President Powers he said:

"Colonel, I feel one of my—"

Mr. Powers arose to assist him. As he tottered for a moment and closed his eyes, the chairman, who had one arm in a sling, reached out to hold him, but he slipped to the floor with a crash. Several of the convention members sprang to their feet and hurried to Mr. Sheerin, but it was apparent that he had died almost as he fell.

Messengers were sent for a doctor, but both of the Auditorium house physicians were out, and the hotel management spent some time trying to find them. It was half an hour before friends of Mr. Sheerin succeeded in bringing Dr. Alfred A. Watson and Dr. J. Mitchell Taylor to the hall. Their efforts at causing artificial respiration were useless.

The convention adjourned immediately after adopting a resolution of respect and appointing an honorary escort to accompany the body to Indianapolis.

During the first day's session it became known as a result of a committee meeting that a contest had developed between various insurance companies throughout the United States and the Independent telephone associations.

For years, the Independent telephone men declare, insurance companies have been charging what the telephone men deem to be excessive rates for insuring telephone switchboards and appliances. An attempt is to be made, it is said, to form a co-operative telephone insurance company.

The only business transacted during the first day's session was the ratification of the movement of several months ago, combining the National Association and the National Interstate Association. It was decided that passage of the resolutions on the death of Mr. Sheerin, and election of officers should be the only business done. All social features of the convention were abandoned.

On Wednesday morning the committee on nominations reported, and on its recommendation the following were elected:

OFFICERS ELECTED,

President—James B. Hoge, Chicago.

First vice-president—Theodore Gary, Macon, Mo.

Second vice-president—John Van Lieu, Los Angeles.

Secretary—A. L. Leu, Nashville.

Treasurer, James B. Splane, Pittsburg.

Mr. A. B. Green Shields presented a paper on "The Value of Telephone Securities," which analyzed the finances of various classes of public service corporations and showed that Independent telephone securities presented decided advantages to the investor.

The committee on standardization of equipment recommended the establishment of a National Bureau to take cognizance of the details of such standardization.

There was a roll-call of States in the afternoon, and the delegate from each State was asked to present information showing the condition of Independent telephony in his State. California reported 20,000 Independent telephones in Los Angeles. Iowa proved to be the banner State, there being 220,000 telephones and a State organization in existence since 1896. Emphasis was placed on the strength which rural lines gave to the Independent movement, this development being the secret of Iowa's success.

Invitations for the next convention were received from Atlantic City, Nashville, Detroit and Put-in-Bay, and were referred to the executive committee.

Mr. W. L. Lunbach read a paper on "Standard Toll Signs," in which he urged the adoption of a uniform sign or trademark for all Independent telephone companies.

A paper by Mr. S. G. McMeen on "Combined Telephony and Telegraphy," was then read by title. An address on the programme by President Hoge, on "The National Interstate Telephone Association," was also read by title, owing to lack of time. The committee on advertising again reported in favor of the red, white and blue sign, and after considerable further discussion its report was adopted. The convention then adjourned its session. Thursday was given up entirely to inspection of exhibits by the members in attendance.

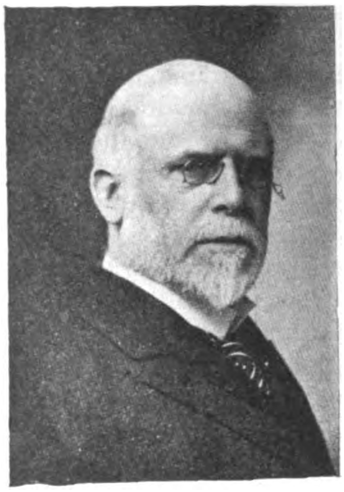
SIMON P. SHEERIN.

It is safe to assert that Mr. Sheerin was the most popular man in the Independent telephone movement and the most prominent Independent telephone magnate in the country.

Mr. Sheerin was born in Dublin, Ireland, February 14, 1846. His father, an Irish revolutionist, left Ireland for the United States in 1849, landing at New Orleans. Later the family located at Dayton, O. In 1875 Mr. Sheerin became the editor of the "Logansport Pharos," one of the important Democratic papers of Indiana.

In 1888, at the Democratic National Convention in St. Louis, Mr. Sheerin was elected a member of the National Convention, and in the same year in Washington was elected secretary of the National Committee. He was re-elected secretary of the National Democratic Convention in 1898. In recent years he had been identified with large enterprises, such as natural gas and telephones, and was president of the New Long Distance Telephone Company of Indianapolis

He is survived by a widow and eight children. Mr. Sheerin had not been in good health for some time, and, although he is said to have suffered an attack similar to this one four years ago, he attributed his indisposition to overwork.



SIMON P. SHEERIN.

New York State Independent Telephone Convention.

At a recent annual meeting of the New York Independent Telephone Association, held in the Common Council Chambers at Albany, about 78 delegates were present, representing the properties of Independent Telephone Companies throughout the State having an investment of more than $15,000,000. After the appointment of the various committees by President Howard Hendrickson, Secretary T. S. Lane made his report.

A resolution was adopted setting forth that inasmuch as several of the State departments are not equipped with Independent telephones it is deemed advisable that an effort be made at once to have such installed. The claim is made that if the rates of the Bell telephone were reduced to the rates of the Independent companies, that both systems might be installed at the cost of one. The matter was referred to the executive committee with full power to act.

The following officers were elected; President, Howard Hendrickson, Albany; first vice-president, Boyd McDowell, Elmira; second vice-president, W. R. Campbell, Niagara Falls; treasurer, T. Harvey Ferris, Utica; secretary, T. S. Lane, Buffalo.

The Morrow County, O., Telephone Company has increased its capital stock from $30,000 to $150,000. Amzi A. Whiting is the president and Mark Cook, the secretary.

The Pataskala & Hebron Telephone Company, Pataskala, O., has increased its capital from $65,000 to $100,000. Frank L. Beam, president, and D. E. Sopp, secretary.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Adairsville, Ga —An election for water and electric light bonds will soon be held here.

Baltimore, Md.—At the annual meeting of the stockholders of the Mount Washington Electric Light & Power Company, held lately at the company's offices, Mount Washington, the following officials were elected for the ensuing year: President and general manager, Thomas W. Offutt; vice-president, Allen S. Miller; secretary and treasurer, Harry J. McIntyre. The company is expending about $100,000 for the building and new machinery, and will have the new plant, which is expected to be one of the best in the country, in operation by September 1.

Chilton, Wis.—The Chilton electric light plant, owned by Nicholas Bink, of this city, has been sold to the American Electric Light, Heat & Cold Storage Company for $20,000.

Covington, Ga.—This city will rebuild the electric light plant during the next 50 days.

Ensley, Ala.—At a recent meeting of the mayor and board of aldermen the initial step was taken looking to the erection of an electric light plant by this city. The practicability of building a plant was referred to the light committee with instructions to get up all the data on the subject, plans and specifications and report back to the council at its regular meeting on July 6 The vote on the question was unanimous.

Fayetteville, Tenn.—The Fayetteville Electric Light Company has contracted for a power house and a stone dam across Elk River about 1½ miles from here above Bonner's Island. The cost is estimated to be about $250,000.

Grayson, Ky.—Claude Wilson, of Olive Hill, has secured franchises here for waterworks, electric light plant and telephone system.

Jacksonville, Fla.—A franchise has been granted to T. R. Osmond for the construction of an electric light plant.

Lehi, Utah.—The Utah Sugar Company will install an electric light plant here.

Melrose, Minn.—This city will have a new electric lighting plant.

Prosser, Wash.—At a recent city council meeting the Prosser Falls Land & Power Company applied for a new electric light franchise. The ordinance will come up for final passage on the first Tuesday in July.

Rock Run, Pa.—There is a movement on foot among the citizens of this place to have electric lights installed here, particularly along the road leading to the village: The officials of Valley Township are going to try to break up the highwaymen's pranks along the Rock Run road, and they see no better way than to have lights along the thoroughfare in question.

San Angelo, Tex.—Plans are being made at Miles for the organization of an electric light company to furnish light and power for the town. The citizens are very desirous of securing this plant, and the installation is a certainty.

Spirit Lake, Ia.—This city is preparing to make a $6,000 improvement on its electric light plant.

Sunny Side, Wash.—This town and Mabton are figuring on putting in electric lights and waterworks and the company will probably make a proposition to not only light both towns, but also to furnish them electric power for manufacturing purposes transmitting the current from the large plant at Prosser that is just being completed.

Thomasville, Ga.—This city has received a donation of $3,000 for the purpose of erecting an electric light plant to light the streets, parks and public buildings of this city. The contribution is from a number of citizens known as the light committee, consisting of F. D. Dismuke, R. H. Neel, N. C. Ball, F. H. Smith and W. H. Brandon.

STREET RAILWAYS.

Albany, N. Y.—The State Board of Railroad Commissioners last week granted the application of the Buffalo, Batavia & Rochester Electric Railway Company to construct the proposed road from Williamsville, through Batavia to Rochester. It is an extension of the Batavia & Williamsville Railway. The company, has a capital of $3,500,000 and the road will be 65 miles long.

Alexandria, La.—T. H. Bush, of Mobile, is at the head of the project to construct an electric street car line in this city.

Alton, Mo.—Officials of the Alton, Jacksonville & Peoria Railway Company recently announced that they expect to begin constructing their electric line in this city.

Bellefonte, Pa.—The State College engineering corps has completed the survey for a trolley road from here to State College, with loops to Milesburg and to Coleville and perhaps other points. Active steps will soon be taken toward the construction of the line.

Bluffton, Ind.—The Fort Wayne, Bluffton & Marion Interurban Company has at last secured a right of way into this city. This was done without the aid or consent of the city council, and as the right of way is all over private grounds, no objection can be raised.

Cleveland, O.—Plans for the entire reorganization of the Eastern Ohio Traction Company were lately prepared by George D. Bishop, H. P. McIntosh, W. D. Rees, H. A. Everett and W. H. Lamprecht after several months of careful investigation and study of the situation. The plans call for the formation of a new company to be known as the Cleveland & Mahoning Valley Traction Company with a capital stock of $3,000,000. The road is to be extended from Garrettsville to Leavitsburg, where it will connect with the Pennsylvania & Mahoning Valley Traction Company to Warren, Youngstown and Newcastle, giving the line an important connection for through travel and some good territory for its own business.

Donalds, S. C.—The question of building an electric line between here and Due West, is again being discussed, and it really looks as if something would be done this time. The promoters of the road are planning to get the electric power from Ware's Shoals.

Magnolia, Miss.—The city council has considered the application of the Magnolia & Summit Electric Railway Company for a franchise. It is understood that the work on the line will be commenced in a short time. The company has been chartered something more than a year, and the promoters have been engaged in securing rights of way and making other preliminary arrangements.

Mansfield, O.—The Cleveland, Ashland & Mansfield Traction Company, of this city, with $1,000 capital, was incorporated by W. H. Abbott, A. J. Halle, C. W. Collister, Frank Butter and H. B. Cavanaugh. The company proposes a traction line between here and Ashland, and a company having the same name consented to the use of it by the new one.

Newark, N. J.—President McCarter, of the Public Service Corporation, has announced that a high-speed electric road is to be built from Park place, Newark, to New York by a subsidiary company. Mr. McCarter said that the scheme has already been financed and that work on the new road will be pushed as rapidly as possible. It is proposed to run at a high rate of speed, so that passengers from Newark can reach the center of New York in less than 30 minutes.

New York City.—For the purpose of introducing the three-phase alternating current electric traction system on steam railroads, the Railway Electric Power Company has been organized with a capitalization of $1,500,000, Among the directors are John Borne, president of the Colonial Trust Company; William L. Bull, of Edward Sweet & Co.; Henry Seligman, Stephen Peabody, H. R. Du Val and Gustave Leve.

Oskaloosa, Ia.—Local business men lately subscribed $130,000 in stock, and the interurban trolley line from here to Buxton is assured.

Riverton, N. J.—The Camden & Trenton Railway Company is trying to get the right of way to run a line through this place and direct to Philadelphia by way of Palmyra and West Palmyra, and thus avoid the necessity of using the Camden & Suburban Road to reach the Camden ferry.

Schenectady, N. Y.—A project is on foot to build and equip a trolley line between this city and Middleburg.

BIDS WANTED.

Brooklyn, N. Y.—Sealed bids or estimates will be received by John T. Oakley, Commissioner of Water Supply, Gas and Electricity, until 2 o'clock P.M., on Wednesday, July 19, for this city, for furnishing constructing and installing three electrically-driven, pumps with all appliances complete, for high-pressure fire service, in a pumping station to be erected on the northwest corner of Willoughby and St. Edward's streets. The time allowed for doing and completing the work will be 220 working days. The security required will be $25,000. Also for furnishing, constructing and installing three electrically-driven pumps, with all appliances complete for high pressure fire service, in a pumping station to be erected on the northeast corner of Furman and Joralemon streets. The time allowed for doing and completing the work will be 220 working days The security required will be $45,000. Bidders shall submit plans with their bids showing the general style of motors and pumps proposed and of the foundations to be provided. No bid will be received unless accompanied by the above plans.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15@15⅛c.; Lake 15⅛@15¼c.; casting, 14¾@14⅞c.

The Electric Storage Battery Company has declared the regular quarterly dividends of 1¼ per cent. on its common and preferred stocks.

The syndicate which bought the $4,000,000 bonds of the Keystone Telephone Company of Philadelphia is headed by Fisk & Robinson of New York.

The Trolley Electric Vehicle Company of America, of Wilmington, Del., has been chartered to carry persons, freight and express; capital, $1,000,000.

The United Gas & Electric Company of New Jersey has declared the regular semi-annual dividend of 2½ per cent. on its preferred stock, payable July 15 to holders of record June 30.

New York and Brooklyn traction stocks were lively during the past week. They are about the easiest stocks to move on account of being controlled by cliques of financiers and politicians.

The Westinghouse Electric & Manufacturing Company has declared the regular quarterly dividends of 2½ per cent. each on its preferred, assenting and non-assenting stocks, payable July 10.

William F. Harrity of Philadelphia, acting for the reorganization committee, bought the franchise and properties of the Lehigh Valley (Pa.) Traction Company at the recent foreclosure sale for $2,000,000.

The entire outstanding issue of bonds of the Cumberland (Tenn.) Light & Power Company, a subsidiary concern of the Nashville Railway & Light Company, has been called for payment on July 1. The issue amounts to $387,000.

The Detroit United Railway Company has declared a dividend of 1¼ per cent. This is an increase of ¼ of 1 per cent. over the previous payment and places the stock on a 5 per cent. basis. The dividend is payable August 1. Books close July 15 and reopen August 2.

From present indications the street railway problem in Chicago is in just as much of a tangle as ever, and investors will not know where they stand in the matter of the value of their securities until the rights of the companies under the old Illinois State law have been defined by the United States Supreme Court.

The Commonwealth Electric Company of Chicago has sold to a syndicate composed of the Merchants' Loan & Trust Company, N. W. Harris & Co., and Russell, Brewster & Co., $1,000,000 of the company's first mortgage 5 per cent. bonds. The price has not been made public, but is understood to have been well above par. The last sale of Commonwealth bonds on the Chicago exchange was at 107.

It is reported in Wall Street that the Long Island Consolidated Electrical Companies, which has a number of well-known Pennsylvania Railroad officials as directors, may be made a holding company for the stocks of the Long Island traction companies, which the Pennsylvania Railroad Company, through the Long Island Railroad Company, and the Interborough Rapid Transit Company have jointly purchased. The Consolidated Electrical Companies is authorized to build and operate or to furnish power for railroads and for other purposes, and to buy and hold the stocks of electrical and railway company.

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STREET RAILWAY STOCKS. Name.	Closing price June 24
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Interborough Rapid Transit	202¼
Manhattan Elevated Railway	164
Metropolitan Street Railway	124¼
Metropolitan Securities	81
Ninth Avenue	197
Third Avenue	131
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	67¾
Brooklyn City Railway	240
New Orleans Railway	..
Public Service Corporation (New Jersey)	121
Philadelphia.	
Consolidated Traction of New Jersey	83¼
Philadelphia Traction	100
Union Traction	59¾
Boston.	
Boston Elevated	157
Massachusetts Electric Companies, com	19¼
do. do. do. pref.	63
West End Street, com	98
do. do. do. pref.	116½
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	6
do. do. pref.	38
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New York City.	
Allis-Chalmers, com	14
do. pref.	51⅛
Electric Boat, com	34
do. do. pref.	75
Electric Lead Reduction	⅛
Electric Vehicle, com	16
do. do. pref.	20
Westinghouse, com	168
do. pref.	190
General Electric	174
Boston.	
Edison Electric Illuminating	245
General Electric	174
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	155
National Carbon, com	67
do. do. pref.	118
Philadelphia.	
Electric Company of America	11⅛
Electric Storage Battery, com	85
do. do. do. pref.	85
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Boston.	
American Telephone & Telegraph Company	142
Western Telephone Company	17¾
New England Telephone Company	188½
New York.	
American Telegraph & Cable Company	90½
Commercial Cable Company	210¼
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New York & New Jersey Telephone Company	172¼
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Western Union Telegraph Company	94
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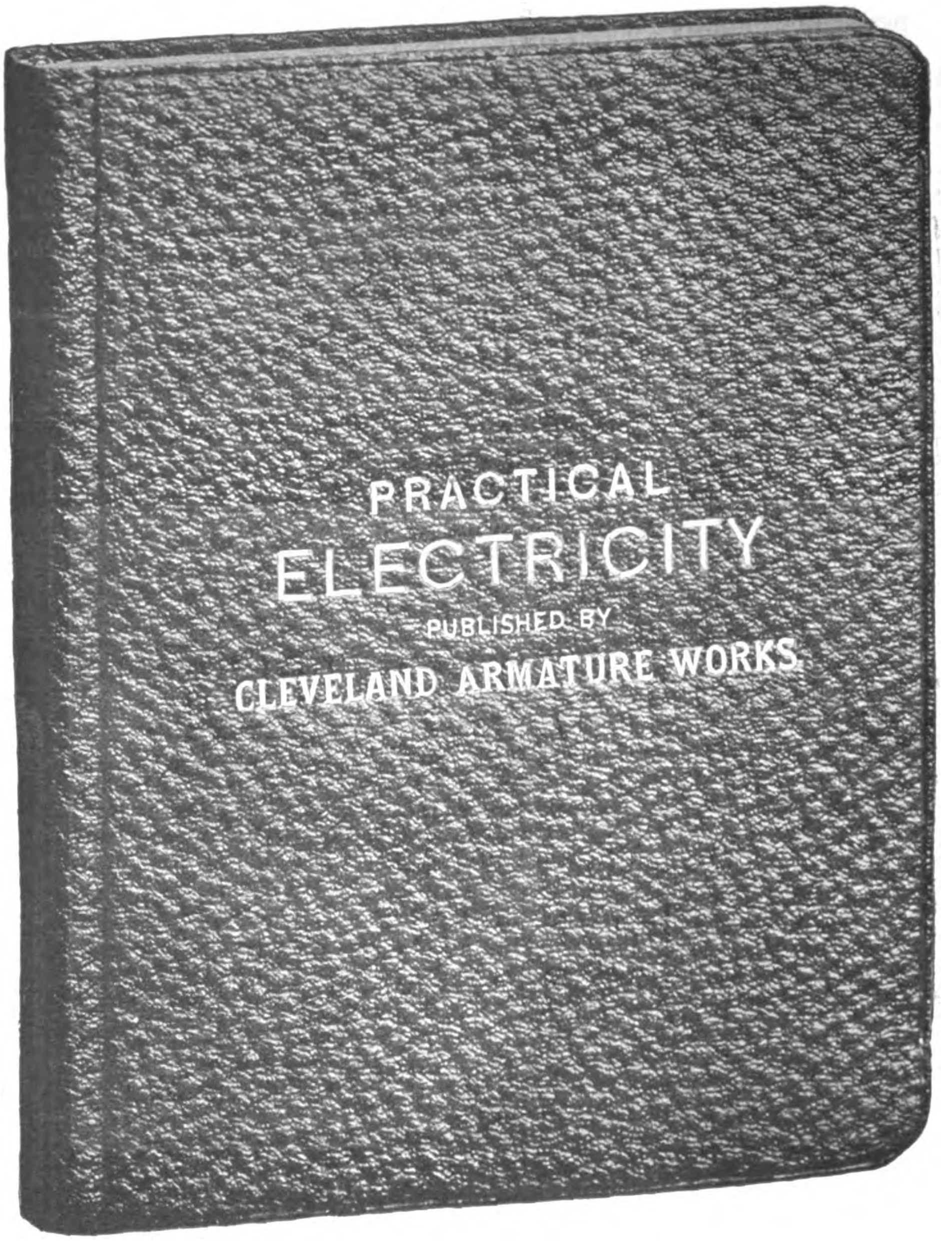

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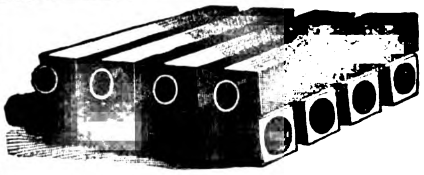

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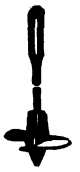

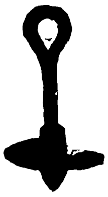

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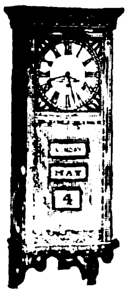

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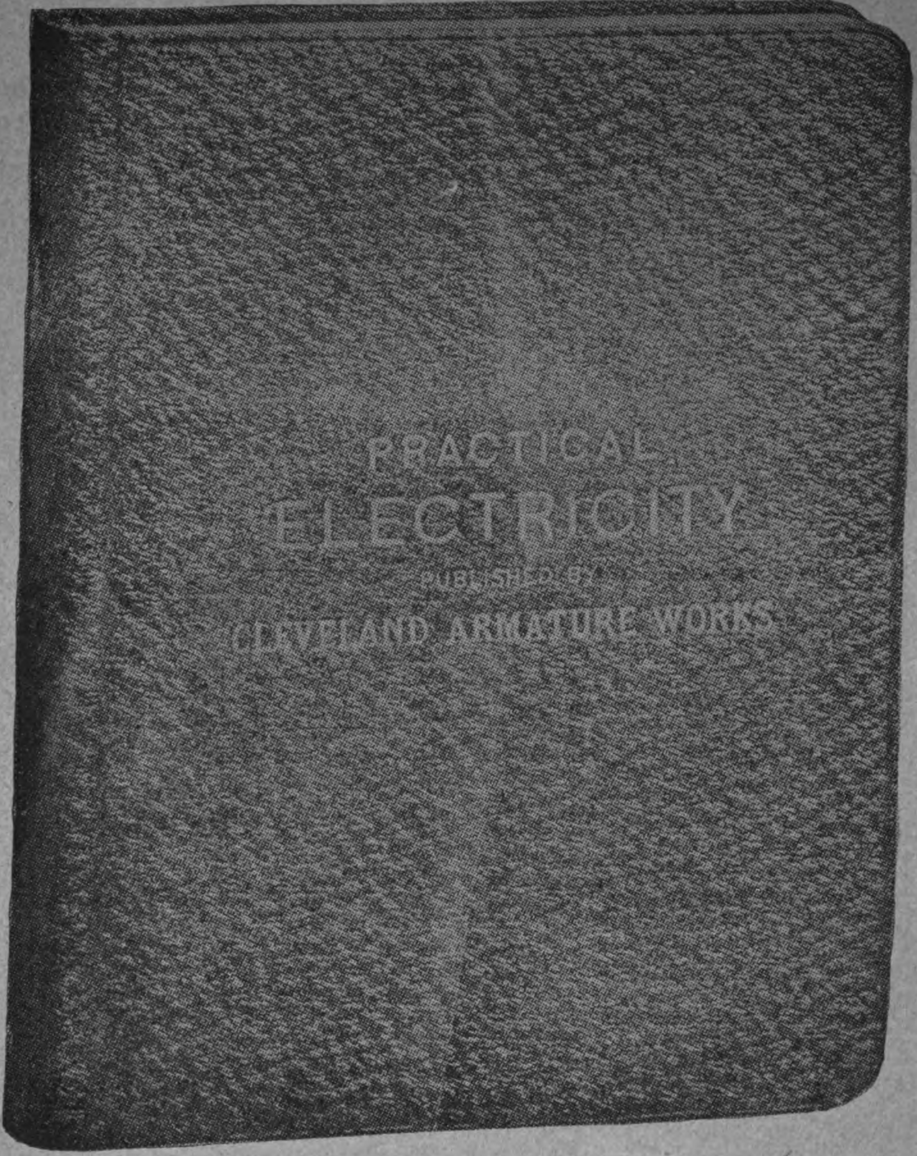

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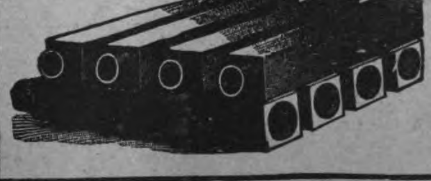

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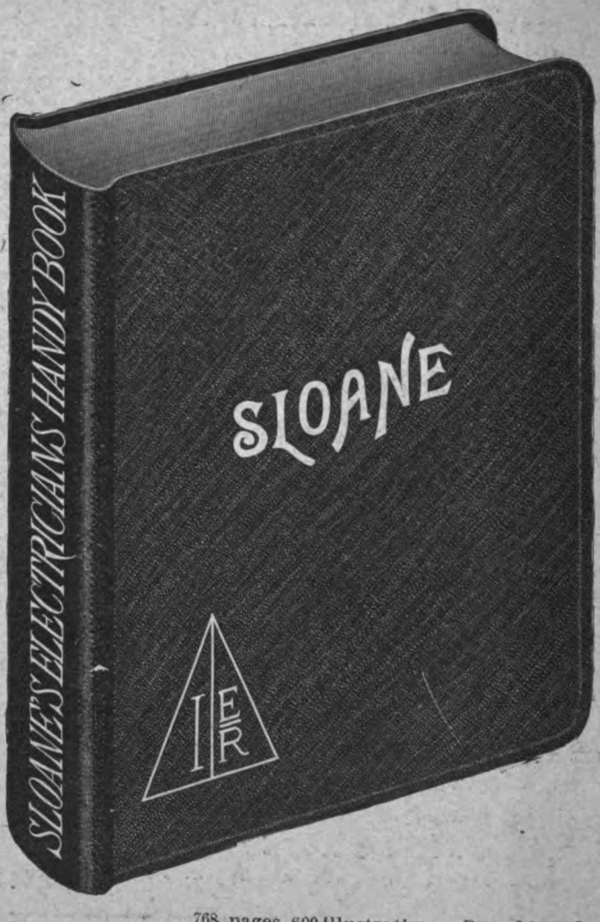

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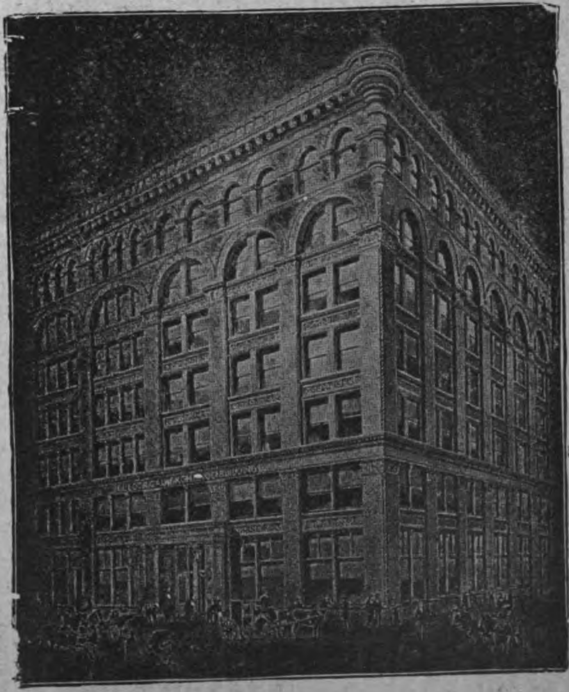

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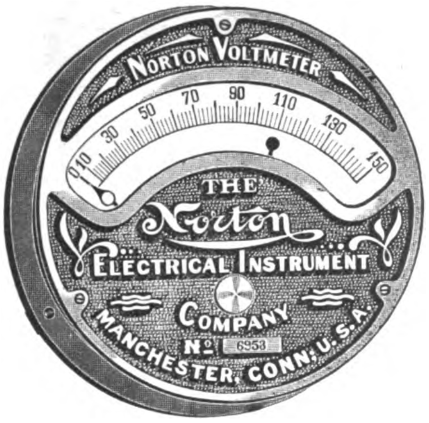
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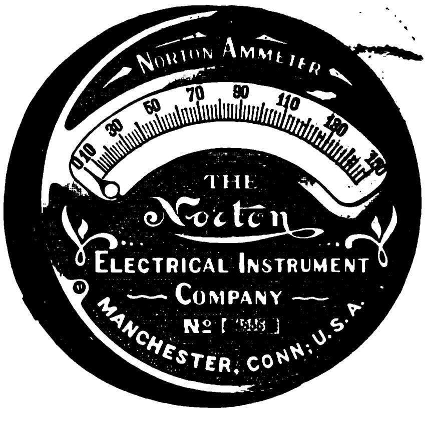
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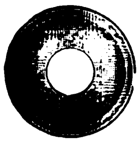

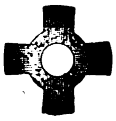

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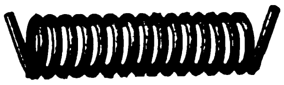

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ELECTRICITY.

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EDITORIAL NOTES.

The Steam Producer in Electric Plants.

The responsibility for the rapid development in engines and boilers rests largely upon the shoulders of our pioneers in electric lighting. The steam producer in electric plants has received a degree of attention that seems to leave little to be desired by those whose inspection of the subject is but casual.

When steady steam pressure is a necessity, combined with an economy that does not threaten the dividends of the plant, a peculiar combination is required in boiler design which partakes of the commercial as well as the engineering aspect.

To get up steam quickly is not so vital a question as to burn the coal properly. By this is not meant the mere combustion of the fuel as it is ordinarily understood, but the use of the fuel in such a manner that as much of its caloric energy as it is possible to get is absorbed by the boiler. The entire proposition is thus seen to be one in which the energy of the coal is absorbed by the boiler. If this is well accomplished a difficult problem has been solved, but not all that relates to boilers by any means. The cleaning of a boiler is of equal importance with this first requirement. A tube boiler whose incrustations are very severe runs the risk of explosion unless frequently cleaned. It is impossible to regulate and purify the water so that every sign of foreign matter is removed. The accumulations from the evaporated water form a heavy sediment which clogs up the tubes and endangers the entire plant. The steam producer is therefore not only to be considered as such but as a sediment producer as well. Alterations in the design of boilers are soon to be expected in the light of the latest applications in steam. A higher pressure and a better economy are demanded for certain purposes. This our most progressive manufacturers are attending to with every credit to their training and talent.

* * *

Activity Among Our Manufacturers.

Originally everything pertaining to electricity belonged to the category of the experimental. The old text books abound in sketches of Leyden jars, static machines, magnets and batteries. The hand magneto was a constant source of mystery, but belonged essentially to the laboratory. With the exception of lightning rods, it can hardly be said that the early days of the history of electricity represented very much in the way of manufacturing. It was not until the telegraph was well established, and electric lighting was elevated from its experimental plane to the dignity of an industry that the phrase "electrical manufacturing" deserved any special consideration. To-day, however, viewed from the standpoint of the merchant, electrical industries are matters of supreme importance. The telegraph, telephone, dynamo, motor, electric light and street railway comprise a collection of applications of electricity which have called into existence large factories. The acreage occupied by these factory sites is beginning to compete with that of the large steel corporations.

The demand for copper, iron and steel has increased so remarkably in the last few years that special agreements have been necessary between the corporations engaged in the exploitation and sale of these commodities.

Activity among our manufacturers has been rapidly increasing of late, not only because of the enormous home consumption of electrical devices and accessories, but through the influence of an incessant demand from the other side for what is now generally known as the better grade of American manufactures. This new requirement or call upon the American manufacturer has had an immensely stimulating effect upon the large plants devoted to the production of what are generally called electrical supplies. The railroads operated by electricity call for large quantities of goods of this nature. When it is considered that by far the greatest amount of electric power generated in the United States is consumed by the street railways and that this, at a rough guess, is unquestionably the heaviest quota of power utilized in the country for any purpose whatsoever, it is easy to realize that with this we find an increasing demand for new equipments as time goes on.

The statistics from which references could be made speak of the hundreds of thousands of horse power in rolling stock and plants. The element of depreciation here, where the severest practice is experienced, means a constant expenditure to make up the wear and tear of travel. The limit is not reached in this respect even under ordinary conditions, for the reason that completely new equipments must be installed before the older ones are worn out. Manufacturers are thus forced to keep up to date to meet the demand. It is the constant newness of electrical appliances that forces our factories up to the limit. This, supplanted by the gigantic nature of important electrical enterprises, means activity in an electrical sense for many months to come.

* * *

A Novel Scheme for Extending Our Export Trade.

A recent issue of the Boston "Herald" contains some excellent suggestions for the promotion of manufacturing interests within the United States as well as for advancing the country's export trade. The suggestions originated with the Massachusetts State Board of Trade in a communication to the Bureau of Manufacturers at Washington.

The document is a lengthy one and full of common sense. Among other things it says:

"Our unused water powers, either for direct power or the generation of electricity, should be utilized to the fullest possible extent. Our tariff laws should permit a much larger entry of raw materials free of duty. Reciprocity with the Dominion of Canada and Newfoundland, or any nation or dependency on this continent should be encouraged and adopted if it will give manufacturing a better opportunity and the United States a more extended market. The best and most improved machinery should be employed in all our mills and factories."

Referring to means that might be adopted for gradually improving our export trade, the communication contains the following:

"We might make one suggestion that may possibly have some flavor of novelty. For years we have had occasion to glance through the consular reports regularly, often reading them with care. While the department is to be congratulated on the considerable development of this important phase of consular work, it seems to us that there is still much room for progress in this direction. In the last 30 years there has grown up a group of publications known as 'trade papers,' which have come to be of very great importance in the industrial and commercial world. To-day each trade and manufacturing field has its organs carefully read by all progressive and ambitious. merchants and manufacturers, edited with ability by men anxious to print all the helpful information they can secure.

"If, acting through the medium of the editor of the consular reports, every member of the consular force could be made an occasional correspondent of every considerable trade paper in the land, information could be disseminated in far greater abundance, and with greater likelihood of its accomplishing the desired purpose, than by the present plan of putting it all into the covers of a single monthly periodical, even though daily bulletins help out somewhat. For instance, if the consul at Bombay or Adelaide or Rio Janeiro were directed to write once a year a letter discussing the chance for electrical apparatus in his vicinity, the electrical papers would gladly print it; the following month let him discuss textiles, the following month iron, steel, hardware, farm implements, and so on.

"This would mean the systematizing of the collection of news and suggestions from our corps of consuls, in place of what appears now to be a somewhat haphazard method of reliance, in whole or in part, on the enterprise and ingenuity of the consul himself."

The above suggestion is certainly original and novel, but if properly carried out good results should follow, and it would undoubtedly meet with the approval of every progressive trade paper editor.

◆

It is stated on reliable authority that $700,000,000 of American money is invested in Mexico in railroads, mines, ranches, street car systems and electric light and power plants.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

A Paris dispatch says that M. Curie, discover of radium, is a candidate for the vacancy in the Academy of Science.

◆

The Boston Electrical Show opens in the Mechanics Bulding, Saturday evening, July 15. Governor Douglas and Mayor Collins will deliver address of welcome. There has been a large demand for space from exhibitors.

◆

The Rapid Transit Commission has granted permission to the Interborough Rapid Transit Company of New York to open and operate the Subway sections to the Battery and under the Harlem River on July 15.

◆

Mr. A. B. du Pont, formerly Superintendent of the Detroit Street Railway system, and at one time second vice-president of the St. Louis Transit Company, has been chosen for supervising engineer for Chicago's proposed municipal lines.

◆

A fire-helmet now under trial in Manchester, England, is equipped with incancent electric lamps, has an air current directed upon eyes and nose to protect them from smoke, and has a telephone to keep the fireman in communication with those outside.

◆

In Barrow, England, where the hemitite iron supply was failing, the electric ore-finder indicated new beds, and boring revealed them, below the limestone, that had previously been thought to bound the ore strata.

◆

An American firm has obtained a big electrical contract from the Government of Peru for building a complete electric railway system at Iquitos and the construction of one of the largest electric lighting and heating plants in South America.

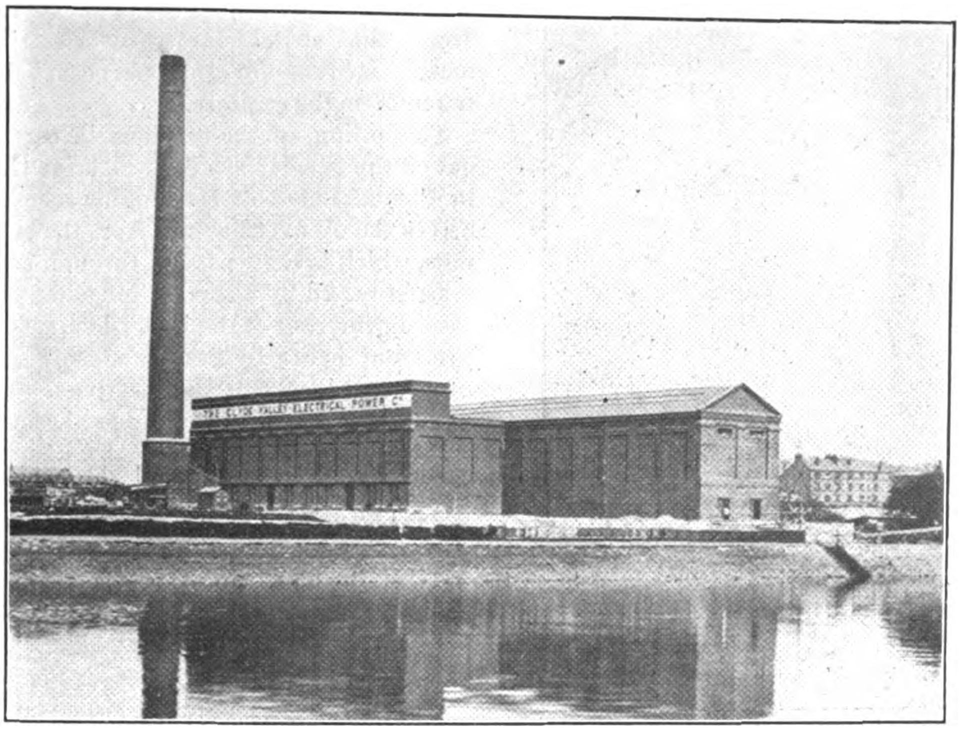
◆

The Brooklyn Heights Railroad Company has closed a contract for two steam turbine electric generating units for extending the present power equipment of the Brooklyn Rapid Transit system. They will be the largest power machines in the world. The contracts call for a maximum guaranteed capacity of about 16,000 hp. each.

ELECTRICAL POWER SUPPLY IN THE CLYDE VALLEY.

(From our London Correspondent.)

When the various electric power supply schemes were introduced a few years ago, one was brought forward by those interested in the manufacturing industries in the district surrounding Glasgow, and this undertaking has now completed its first power station and system. The area in which the Clyde Valley Electrical Power Company, Limited, will operate, extends along the Clyde Valley from Craigdoran and Port Glasgow on the west, to Lanark and Shotts on the east, altogether some 750 square miles, containing the most important manufacturing and coal producing district in Scotland. There are two generating stations, one at Yoker and the other at Motherwell—5 and 15 miles out of Glasgow respectively; various sub-stations are dotted over the area.

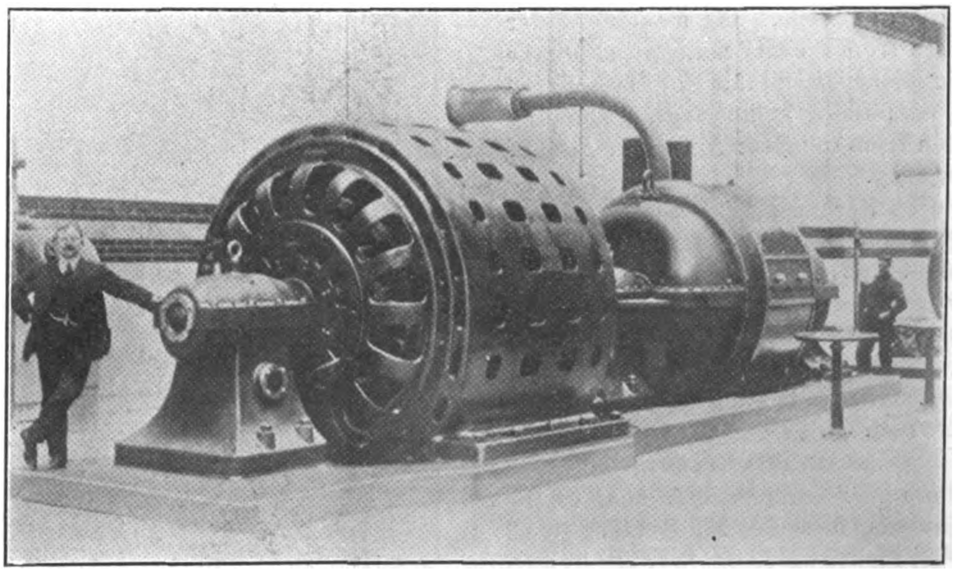


Clyde Valley Power Station at Yoker.

The Yoker generating station, of which a view is given, is situated on the banks of the Clyde, where an unfailing supply of water for condensing purposes is available. The Motherwell station being situated at a higher elevation, and above the level of the River Clyde, depends for its water supply for condensing, on electric pumps working against a head of 140 feet.

In the boiler-house there are at present four double-drum Babcock & Wilcox water tube boilers, each having a heating surface of 4,400 square feet, and fitted with superheaters capable of imparting 140 degs. F. of superheat. The boilers are connected to a main flue passing along the back, and a Green's economizer of two sections and 432 ten-foot tubes is installed. The chimney is built on the Alphons Custodis principle.

Each of the boilers is fitted with a Roney mechanical stoker, and adapted for burning efficiently a cheap class of coal. These are driven through special worm gearing by two 4½ inch by 4 inch 5 hp. Westinghouse standard engines, running at 400 r.p.m., and situated in the boiler house.



Generator End of a 2,000-kw. Turbo Set at Yoker.

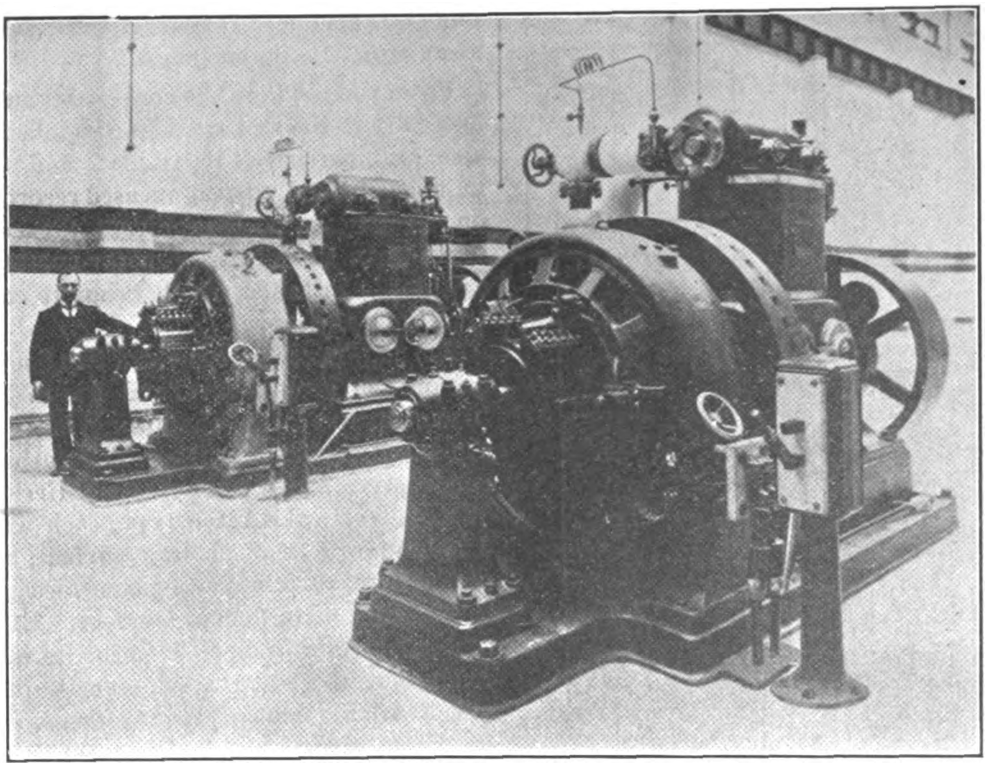
The coaling arrangements of the power station are most complete and from start to finish the fuel is untouched by hand. Coal is brought in wagons to the company's private siding where it is dumped by a hydraulic ram into the crusher pit passing through a crusher and screen operated by a 10 hp. inclosed shunt motor running at 650 r.p.m. It is there picked up by a bucket conveyor and carried to the storage bunkers over the boiler house. This conveyor, which is driven by a 15 hp. inclosed shunt wound motor, is also used for carrying the ashes away from the boiler house.

From the bunkers the coal passes automatically to the stokers, being weighed—also automatically—in transit, and the number of hundred weights used recorded on an indicator. To prevent the coal sticking in the shoots a motor-operated agitator is installed which keeps it constantly on the move.

The engine room consists of two floors, one on the ground level and one in the basement, the latter containing most of the auxiliary machinery. The turbine condensers, which are of the Mirrlees Watson vertical surface type, each with 6,250 square feet of cooling surface, are placed here, their upper ends projecting through the main floor a few feet. Each turbine exhausts directly into its own condenser, and each condenser is provided with a steam-driven, two-stage, dry air pump, situated in the basement. Arrangements have also been made for exhausting to atmosphere if necessary.

The circulating water for the condenser is drawn from the Clyde, running by gravity into a large circular well 18 feet in diameter and of a depth below the water level of 9 feet. There are two 30-inch pipes leading into the well from the river, and the water is drawn out through a 36 inch cast-iron pipe by means of a steam-driven centrifugal pump placed in the basement.

After passing through the condensers the water is discharged by a 36-inch pipe into a tank on the bank of the river. The condensed water is pumped into the hotwell, which is also in the basement, by a centrifugal pump driven by a 6 hp. vertical shaft shunt-wound motor running at 625 r.p.m. From here it passes to the suction of the two feed pumps, which are of Messrs. J. and P. Hall & Sons' tandem, compound, double-acting type, each capable of delivering 9,500 gallons per hour against a boiler pressure of 175 pounds. The make-up water is taken from the city mains, that of the Clyde being unsuitable for boiler-feed purposes; there is, however, a stand-by suction from the river for use in case of emergency.



Exciter Sets at Yoker.

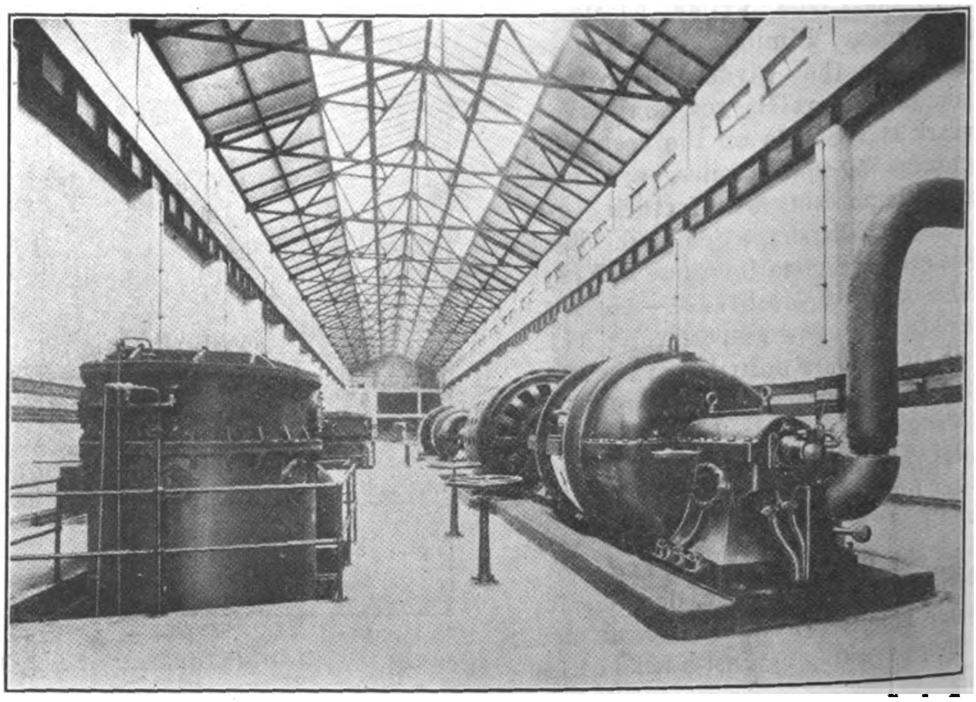
The exciter sets have their separate surface condenser which is of the Worthington Pump Company's make, and has 600 square feet of cooling surface.

In addition to the above auxiliary plant there is installed a feed water heater, having a heating surface of 700 square feet.

GENERATING PLANT.

The upper and principal floor of the engine room measures 252 feet long by 43 feet 5½ inches wide. It is well lighted from the roof, the walls are faced with white glazed bricks, and the floor throughout is paved with Italian mosaic work. At the north end are situated the switchboard galleries and offices.

The main generating plant at present installed consists of two Westinghouse-Parsons steam turbine units, each with a normal capacity of 2,000 kw. and an overload capacity of 3,000 kw. The speed is 1,500 r.p.m., which corresponds to a peripheral velocity of the rotating part of 5 miles per minute. The turbines are of the latest double flow pattern, steam entering at the center and exhausting at both ends, and each contains no less than 20,000 blades. These are securely fixed to the steel drum and are of drop forged steel in the first series, and special metal at the low pressure end so as to prevent corrosion due to the wetness of the steam. The cylinder is of close-grained cast iron, and the rotor consists of a rolled steel drum fixed to the shaft by the aid of forged steel umbrella-shaped disks shrunk into the drum and pressed on to the shaft.



Engine Room at Yoker.

Each of the turbines is directly connected to a 2,000 kw., 11,000 volt, 3 phase, 25 cycle, generator of the rotating field type.

The starting, stopping and speed variations of the generators are under control from the switchboards by electrical means, current for this purpose being taken from the exciters.

The oiling of the turbines is carried out on the gravity system. A large tank in the basement of the engine room receives the oil overflowing from the bearings, which is then passed through coolers and raised by a special oil pump to a tank in the roof of the boiler house, flowing from thence by gravity under a head of 50 feet back to the bearings. Oil pressure gauges are provided on the latter in order to indicate at a glance how the apparatus is working.

The engine room as at present constructed will accommodate one more 2,000 kw. set and a fourth unit of 3,500 kw., which will eventually make the total capacity of the station 9,500 kw. The additional sets will be added as soon as one of the present units is loaded up so that there will be always one spare ready at any moment in case of accident.

The two exciter sets situated at the south end of the engine room are each capable of furnishing the exciting current for both the main generating units at present installed. They are of 75 kw. capacity each, and consist of 11 by x 19 x 11 inches vertical, compound engine, running at 290 r.p.m. coupled direct to a 125 volt compound wound dynamo.

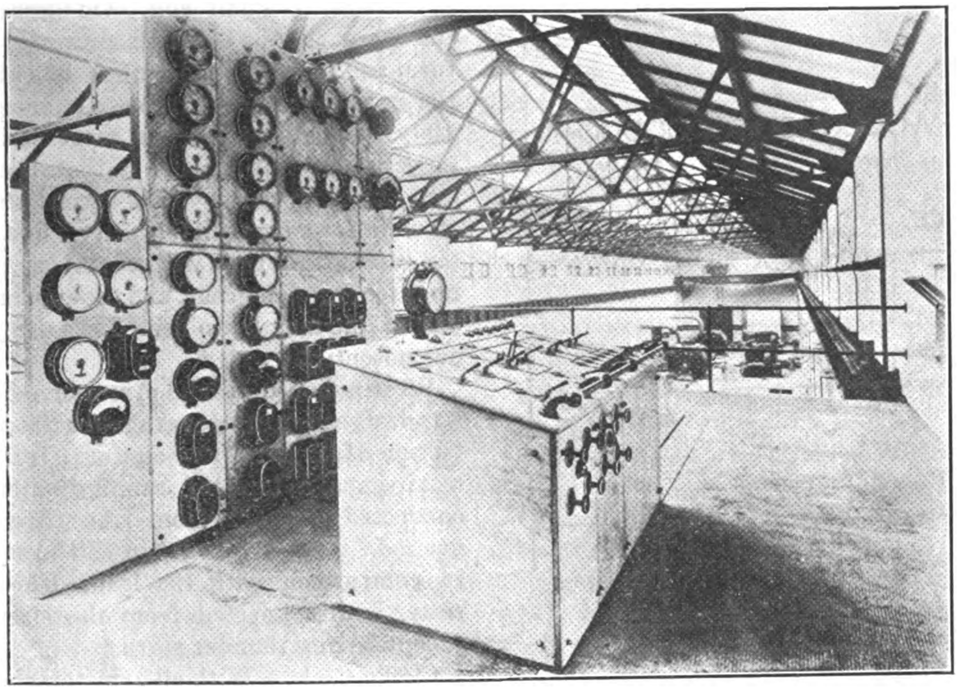
In addition to their natural function these exciters supply current for operating the motors of the coal and ash conveyor, crushers, agitators, economizers, pumps, traveling crane, etc., and also for the electrically operated main and other switches.

The traveling crane in the case of Yoker has a span of 42 feet. It is of 30 tons capacity, of the 3-motor type.

SWITCHGEAR.

The whole of the switchgear is contained in the three galleries at the south end of the engine room. That on the ground floor and the first gallery are devoted to the oil switches and feeders.

On the third or top gallery of the switchboard, are placed the main bus bars in brick compartments and the main controlling board as well as the resistances, etc. Following the latest practice, the control board consists of a small desk directly facing the various instruments, such as ammeters, voltmeters, power factor indicators, relays, etc.



Instrument Board at Yoker.

All the main switches and smaller gear are electrically operated from this desk by the exciter current as before mentioned, and the speed of the turbo-generators and their starting and stopping is also controlled from here.

The Yoker and Motherwell power stations are of the same size and almost identical in arrangement; the foregoing description therefore applies generally to both, with the exception of the condensing arrangements.

DISTRIBUTION.

Six feeders are provided for distribution from Yoker, and all are protected where they enter the building in the basement by lightning arresters.

The cables for supplying power to any part of the district between Clydebank and Scotstoun as well as to Temple are practically finished. They are all laid in duplicate, so that in case of any accident happening to one of them the spare one can be immediately connected while the duplicate is being repaired.

The Clyde Valley Company is authorized to supply in the adjacent Burgh of Clydebank, and for this purpose a special plant has been installed at Yoker consisting of two 150 kw. motor-generator sets. Each set is provided with a small motor coupled direct to the shaft which serves for starting and running up to speed.

The motor-generators are situated in the first switch gallery of the Yoker power station, and the switchboard controlling the distribution to this area is placed on the top gallery.

Both the high and low tension cables for the Clydebank district were supplied and laid by Messrs. W. T. Henley's Co., and the British Insulated Wire Company carried out the extra high tension cable work throughout the entire area.

The number of sub-stations at present installed in the layout of the scheme is ten for the Motherwell district and two for Yoker.

These two districts will not at present be connected in any way, although they may be in the future.

◆

A so-called radium clock, "warranted" to run for 2,000 years, recently came over from England on the Campania for a Rochester, N. Y., electrician.

DESCRIPTION OF THE MAIN PARTS OF STANDARD ARRESTERS.*

BY ALEX DOW AND ROBERT S. STEWART.

ALTERNATING CURRENT.

General Electric Arrester for 2,000 Volts.—Two one-thirty-second-inch air gaps are connected from line to earth in series with a non-inductive high resistance. Cylinders are large, to give a large cooling surface for the arc. The current is kept low by the high resistance used. For protection from stresses between the separate wires of line, half of the gaps are cut out by a bridge connecting the two cylinders which are midway between the line and earth. The arrester thus connected will have the same number of gaps between the lines as from the line to earth. For very high-voltage systems several arresters are connected in series, This arrester should protect very well from ordinary disturbances, but the high resistance does not permit of rapidly dissipating the large amount of energy in a lightning flash.

Westinghouse Arrester for 2,000 Volts.—Six one-thirty-second-inch air gaps are in series from line to earth. Cylinders are made of non-arcing metal. No resistance is used with this when connected to lines fed by 2,200-volt generators of moderate size. When a higher potential than 2,200 volts is used more gaps are used and a resistance is connected in series with the arrester to prevent an excessive current from the generator flowing through the arrester. This arrester protects from severe flashes very well, but as the length of air gap is longer than in the General Electric arrester, a higher difference of potential is required to break down the gap. On discharging a line that has a static charge oscillating waves may be set up in the circuit, since no resistance is used.

These two arresters show how differently two companies will sometimes reason in designing apparatus for the same service.

Westinghouse Low-Equivalent Arrester.—This was designed five years ago in order to cut down the number of gaps required in the standard arrester when used on very high voltage circuits. It consists of a small number of gaps which should break down at a little above the line voltage. In series with these is a high resistance, and shunted across this resistance is a second set of gaps equal in number to the first set. In series with the whole arrester is a small non-inductive resistance, to keep down the main current. Non-arcing metal is used for the cylinders. The operation is as follows: If the potential of the circuit increases, the series gaps break down immediately. As the resistance of these gaps when broken down is small compared with the high resistance in series with them, practically full-potential strain is put on the gaps shunted across this resistance and they will break down. After the static discharge the arc immediately dies out in the shunted gaps, if the arrester is properly designed, and the high resistance cuts the current so low in the series gaps that the arc in these is next extinguished. This arrester combines the good qualities of both those already described for it furnishes a high-resistance path for small static discharges and a low-resistance for violent discharges.

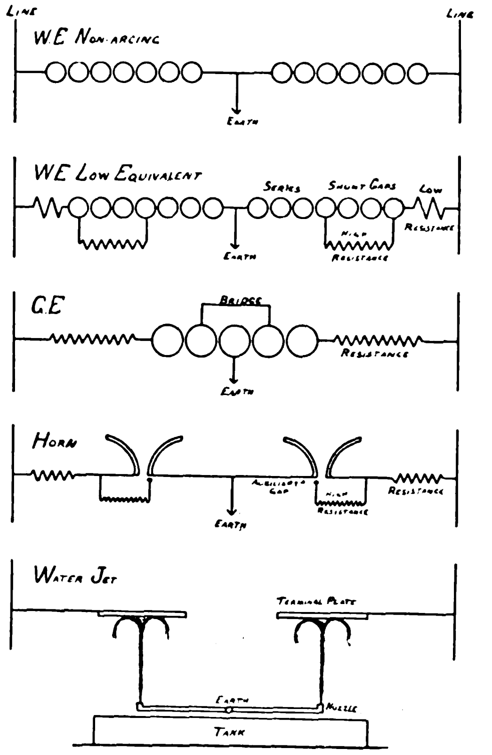
---

*Paper read before the National Electric Light Association at its 28th convention, held at Denver-Colorado-Springs, Col., June 6-11, 1905.

It was the privilege of one of the writers to install the first of these arresters. A considerable amount of lightning trouble had been experienced with a high voltage generator, several generator coils and a transformer having been burned out in a single year. The generator always ran through heavy thunder storms but a little lightning anywhere along the line would cause trouble. The trouble was always due to short-circuits, the discharges never going to earth except through the arresters. The arresters were changed by shunting part of the gaps by a high resistance. No trouble had been reported from this plant three years after this change was made.

Horn Arrester.—This consists of a single large gap, the sides of which are horn-shaped metal pieces to which iron pieces are fastened. The theory of the arrester is that the discharge across the gap sets up a magnetic field, which is distorted by the iron pole pieces. This field draws up the arc which follows the discharge to a point where the field will be symmetrical around the arc. At this point the gap will be so long that the arc will be extinguished, provided the current through the arrester is kept low by a non-inductive resistance. When used on very high voltage systems the air-gap has to be very large to prevent excessive current across the gap. To remedy this fault a small auxiliary gap and a high resistance are shunted across the main gap. When a discharge occurs across the auxiliary gap the heat of this starts an arc across the main gap. This would seem to be a defect, for by the time the arc had started across the main gap all the damage might have been done by the static wave. The reports concerning this arrester are too meagre for us to judge of its operation. It is used on several lines in Europe, but has been tried very little in this country.

Water Jet Arrester.—Water jet discharge devices have been used on some of the high-voltage transmission lines in Europe, and these are reported to be operating very satisfactorily. Jets of water are thrown from a grounded nozzle against terminal plates that are connected to the several wires of the circuit. These columns of water furnish high non inductive resistance paths from the line to earth for any static waves. The power lost is said to be about three kilowatts, and the water used less than one gallon per minute. It would seem that the resistance of the water columns must be so high that it could not dissipate the energy of a violent disturbance with sufficient rapidity.



LIGHTNING ARRESTER DIAGRAMS.

Direct Current Arresters.—In direct current service the arc formed by a discharge is much harder to extinguish than in alternating current service. Fortunately, however, direct current voltages are usually small.

Thomson Magnetic Blow-Out Arrester.—In this the single air-gap is between two metallic horns. An electro-magnet is placed with its poles opposite the lower extremity of the gap. This magnet is excited either by the discharge current or by the main-line current. The magnetic field set up blows out the arc immediately. The operation of this arrester is very satisfactory.

Westinghouse Direct Current Arrester.—This is built in accordance with the principle that if the voltage across a gap is very low no arc will be maintained in the gap. A large number of minute gaps are connected in series. Carbon particles are used to form the sides of these gaps. It is necessary in this arrester to keep the lines of carbon particles protected from the air, or an arc will be carried across the air above the carbon and will burn up the arrester. The objection to this arrester has sometimes been made that its operation has to be taken on faith. There is no evidence of discharge unless one is observing the arrester at the time of discharge. Tell-tale papers in a small auxiliary gap connected in series with the arrester would be advisable.

Garton Arrester.—Two gaps are connected in series with a non-inductive resistance. Shunted across part of this resistance is a small coil. On discharge the current in the coil lifts an iron armature, and increases the length of one of the gaps so much that the arc is immediately extinguished. The most serious objection to this arrester is that it contains moving parts. If a second static wave follows immediately after a first the air-gap at this time will be so long that no discharge can occur, and the apparatus on the line may be subjected to a dangerous potential.

Westinghouse Tank Arrester.—This was designed many years ago for the protection of large railway stations. Instead of air-gaps, a tank of running water is connected directly from the line to ground. The current taken will be small in comparison with the load. The arrester is disconnected from the circuit, except during thunder storms.

Choke Coils.—With all arresters choke coils are placed between the arrester and the apparatus to be protected.

A coil of wire offers opposition to the passage of an electric discharge through it. The more sudden the discharge the greater will be the opposition. The opposing EMF. in the choke coil may be so high that the path across the air-gap of an arrester will be easier than through the coil. In the case of lightning the discharges are either very sudden or they are oscillatory discharges of very high frequency, and a coil which offers practically no opposition to the main current is sufficient. The potential at a choke is greater than it would be if the coil were not present, for the potential is the resultant of the advancing wave and of the wave that is reflected by the coil. This resultant will always be greater than that of the advancing wave alone. It is standard practice to divide a choke coil into several parts and to place arresters between these so as to furnish paths to earth for any discharge that has passed the first arrester.

Distribution of Arresters.—In long-distance transmission the lines need no protection and the arresters are grouped at the two ends of the line. Several choke coils are used, and the arresters are connected to the line at several places between the coils, so as to be sure that some of the arresters will be at a maximum point of a static wave.

In distribution networks arresters should be scattered all over the network. There is no general rule as to the number necessary, except that the more arresters installed the better the protection.

In low-voltage networks that are tied together in many places, if one branch extends some distance from the network, weak spots near the end of the branch are punctured by discharges during thunder storms. Experiments with static machines and small networks of conductors showed the same phenomenon many years ago. A static wave traveling down the conductor is reflected back at the end of the conductor. The resultant of the advancing and reflected waves gives at the end of the line a potential strain that is double that of the advancing wave.

The remedy is to put choke coils in the branch at the point where it is connected to the network. The wave in the network will then be divided at the coil, part being reflected at this point and only a small part advancing along the branch.

Overhead Ground Wires.—In many long-distance transmission systems the lines are protected by ground wires strung above the lines. These ground wires are connected to earth every thousand feet. The theory is: If lightning strikes the line the ground wire would be struck directly instead of the line wires that are insulated from ground. As the earth's potential is above and also below the line wires these cannot be charged with static to a high potential. The inductive action of lightning on the line is much reduced, as the ground wire is much nearer the line than the earth is.

There is one case in which ground wires are of no service. If the earth and a cloud are charged, the line is charged to the same potential as the earth. If a disruptive discharge occurs, the line, being insulated from earth, is discharged much more slowly, and there may be a great difference of potential between the line and earth. Arresters would be required to protect the line from such strains. A ground wire is also no protection from strains caused by high-frequency waves that are set up in a circuit by sudden changes of load or by resonance.

The result of years of test has been favorable to ground wires in many cases. It is particularly noticeable that on lines provided with ground wires poles are not split by lightning.

Theoretically, barbed wire should be used for an overhead ground wire, as the points of the barbs draw off the charge from the suroundin air. The action is the same as that of the comb in a static machine. In practice, however, there does not seem to be any gain in the use of barbed wire. It is very difficult to string on poles, the points are far from being theoretical points, and the wire is of a poor grade. These disadvantages more than offset the theoretical advantages. A good construction would be No. 8 B. & S. gauge E.B.B. wire, strung on glass insulators, and grounded every thousand feet. The two outside pins on the top cross-arm are sometimes used for ground wires, but as the construction is expensive and there is some difficulty in connecting the wires to ground, a single ground wire, either above or below the circuit, is more frequently employed. Glass insulators are used so as not to subject the pole to any unnecessary electric strain from the line.

Conclusion.—There is still much to be done before we can claim to have our lines perfectly protected. The engineers of the manufacturing companies have developed apparatus that operates successfully under ordinary conditions, but each transmission line is a separate problem and can only be solved empirically. Complete records of static troubles and, so far as can be determined, their causes, should be kept by the different power companies to show how their apparatus is affected by the local conditions.

Automatic Ticket-Machine.

An interesting application of the slot principle has been made in England, where the Lancashire & Yorkshire Railway Company has introduced an automatic ticket-machine at a point where a large number of tickets for a neighboring station are sold. The machine is of simple construction, and when the coin is dropped into the slot and a handle pulled the ticket is dropped into an open receptacle. If the machines prove successful in operation it is proposed to install a large number at suburban stations, not only with the purpose of relieving the ticket office, especially during rush hours, but to enable passengers to purchase their tickets more speedily without waiting in a line at the window.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

THE TRANSMISSION OF POWER.

Efficiency in Transmission.—Whether direct or alternating current is employed, the efficiency or percentage of power returned, from the total sent into the line, demands attention. The problem of transmitting 100 hp. a given distance requires consideration based upon the conditions as follows: The drop in the line, the power wasted in the line, the pressure, the cost of copper employed, the relation between the cost of copper and the power wasted in transmission, and other data of importance. To examine a specific case according to the general ideas prevailing, take 100 hp. transmitted a distance of one mile with 10 per cent. drop. If the engine or turbine shows 100 indicated horse power, then the dynamo transforms 95 per cent. into electrical energy. When 95 per cent. or 95 hp. enters the line only 90 per cent. is delivered at the other end. The power delivered at the distant end of the line is 95 hp. minus 9.5 hp., leaving a balance of 85.5 hp. The process is not complete as yet, although the power is now at hand, ready for use. It is necessary to transform it again into mechanical energy. This transformation roughly involves a loss of from 5 to 10 per cent. This being the case the balance left will be the difference between 85.5 — 8.55 = 76.95 at 10 per cent. loss in the motor, or the difference between 85.5 — 4.275 = 81.225 per cent. at 5 per cent. loss in the motor. The efficiency of transmission in any case, with 100 hp. at one end, and the loss throughout in dynamo, line and motor of 10 per cent. apiece respectively, will be about 77 per cent. The 100 hp. is thus reduced to 77 hp. from the beginning to the end of the system. The question arising in connection with this subject is that of the cost of transmission. The actual transmission can be readily accomplished if the cost is not prohibitive, but in instances where this threatens to be the case, certain means must be employed to raise the efficiency and reduce the cost of installation.

A Higher Efficiency and a Lower Cost. —When power is subtracted from the total amount sent into the line, it disappears in the form of heat. It is called the C^2R loss, and is due to the degradation of electrical energy through resistance. This loss is serious in character and increases rapidly with any increase in current in the line. The relationship of power loss in transmission, to the number of amperes in the line, is shown by the following figures:

Amperes.	Volts.	Distance in Miles.	Resistance in Ohms.	Total Drop in Volts.	Loss in Heat in Watts.
10	1,000	1	10	100	1,000
9	1,111	1	11	99	891
8	1,250	1	12	96	768
7	1,428	1	13	91	637
6	1,667	1	14	84	504
5	2,000	1	15	75	375
4	2,500	1	16	64	256
3	3,333	1	17	51	153
2	5,000	1	18	36	72
1	10,000	1	19	19	19

The above figures illustrate the influence of a diminishing current and an increasing resistance upon the losses experienced in the line. The amperes are shown to diminish systematically, the volts to increase in like manner, but the total amount of power is kept constant. The loss of watts due to the current and resistance is shown to diminish with increasing voltage and even with increasing resistances.

The greater losses are those involved in the use of a heavy current. One of the axioms therefore of power transmission is that of keeping the current at a minimum. The conclusion to be drawn from this proposition is that the only way in which the watts wasted can be limited is by the employment of high pressures in transmitting the power. In the first line of figures given, the total drop with 10 ohms and 10 amperes is 100 volts. It is readily seen that 100 volts drop with 10 amperes in the line would mean the loss of 1,000 volts. The loss in volts and the loss in power are equally indicators of the percentage of power dissipated. For instance, a loss of 100 volts out of 1,000, shows a waste of 10 per cent. Similarly a resistance of 10 ohms causing this 100 volt drop causes a waste of 1,000 watts of power or 10 per cent. of 10,000 volts, the total power to be transmitted.

Effects of an Increased Pressure.—The transmission of power over a line in which the following conditions occur will illustrate another feature in connection with this subject. Suppose a power line a mile in length is erected whose total resistance is 2 ohms. If 10 kilowatts of power are to be transmitted at a pressure which is to be varied to obtain the most economic results, then the following considerations must be observed: The effect of an increasing pressure—the total amount of power remaining the same and the resistance of the line not varying—will be that of greatly improving the operation of the system. This improvement will manifest itself in a reduced loss in transmission, collectively represented by less drop and therefore less loss in heat. In the case specified 10 kilowatts of power represent 10,000 watts, which, at a pressure of 100 volts, will call for a current of 100 amperes. In a line whose resistance is 1 ohm, the total energy would be wasted in heat and the total pressure in drop. This is readily shown by squaring the current and multiplying it by the resistance, or 100 × 100 × 1 = 10,000 watts dissipated in heat, or 100 × 1 = 100 volts lost in transmission. This entire degradation of the sum total of power into heat illustrates a case in which the efficiency is zero. There is no return at the other end, and the line therefore, with respect to the conditions under which the power is being transmitted, is totally unsuited to the particular pressure employed. To carry out the idea further, let the pressure be raised to 10 times its value, which is 1,000 volts. Let the results of this change be carefully examined with respect to the applicability of the line as it is at present, that is, 1 ohm resistance. Under these circumstances 10,000 watts at 1,000 volts would mean a current of 10 amperes. At 1 ohm resistance, as stated in the line, the drop would be 10 × 1 = 10 volts. The loss in heat would be 10 × 10 × 1 = 100 volts. The influence of pressure therefore is manifested as follows: The increase of pressure to 10 times its original value, namely, from 100 to 1,000 volts, has had the effect of reducing the heat loss from 10,000 watts, representing the waste of all the power, to 100 watts, or only 1 per cent. of the power. Raising the pressure to 10 times its value has reduced the loss down to $\frac{1}{100}$ of its value. This relationship will be clearly shown in other ways in connection with power transmission problems. The fundamental fact is thus presented, that if the resistance of a line remains constant and the power constant, but the pressure increases, the loss becomes reduced inversely as the square of the pressure. According to this statement, doubling or tripling the pressure, the total power and line resistance remaining the same, means a reduction of the heat loss to $\frac{1}{4}$ or $\frac{1}{9}$ of its value with the original pressure.

TABLE SHOWING THE EFFECT OF A HIGHER PRESSURE IN TRANSMISSION.

Amperes.	Total Watts.	Volts.	Resistance of Line in Ohms.	Distance in Feet.	Drop.	C^2R in Watts.
1,000	100,000	100	10	50,000	10,000	Complete loss.
500	"	200	"	"	5,000	" "
250	"	400	"	"	2,500	" "
200	"	500	"	"	2,000	" "
100	"	1,000	"	"	1,000	100,000
50	"	2,000	"	"	500	25,000
40	"	2,500	"	"	400	16,000
25	"	4,000	"	"	250	6,250
20	"	5,000	"	"	200	4,000
10	"	10,000	"	"	100	1,000
5	"	20,000	"	"	50	250
2.5	"	40,000	"	"	25	62.5
1.0	"	100,000	"	"	10	10.0

The efficiencies will rapidly rise according to these figures as soon as a point is reached where the better effects of an increased pressure can make itself felt. The dead loss experienced in a 10-ohm line is felt all along until 1,000 volts have been passed. At this point 100 amperes are employed to give the full quota of power. The loss is complete however in the line. One thousand volts disappear as pressure, and 100,000 watts as power. With an increase in pressure, however, the conditions change for the better. The pressure is doubled, which would mean, according to the principle outlined, that the loss becomes one-quarter. Following the 2,000 volt pressure along to the loss in watts, it is seen that the dissipation of energy has become only 25,000 watts. Passing from the 1,000 volts with 100,000 watts loss, to four times the pressure or 4,000 volts, the loss is shown to be $\frac{1}{16}$ or only 6,250 watts. Following the 4,000 volts up to 10,000 volts, the loss becomes $\frac{1}{100}$ or only 1,000 watts. The immediate practical value of high pressures in power transmission is thus exemplified in showing as well the small loss in volts. Power transmission under these circumstances becomes a matter of high pressure to be successfully conducted and, as naturally follows, a matter of high grade insulation. The efficiency with 1,000 volts is zero in the foregoing table; with 2,000 volts it becomes 75 per cent.; with 4,000 volts it becomes 93¾ per cent., etc. These ideal figures merely serve to show the trend of an intelligent practice. When everything is considered, the efficiency falls very much lower though the chance of sustaining it lies in the pressure and line resistance. The decision regarding the line resistance is really a conclusion regarding its cost as copper. It does not take into consideration the cost of high grade insulators. It leaves out the question of poles and the cost of installing them. In fact, the principal problems are those, which, when solved satisfactorily in an electrical sense, call for financial consideration. The problem of the line becomes a fourfold one with regard to the engineering difficulties involved.

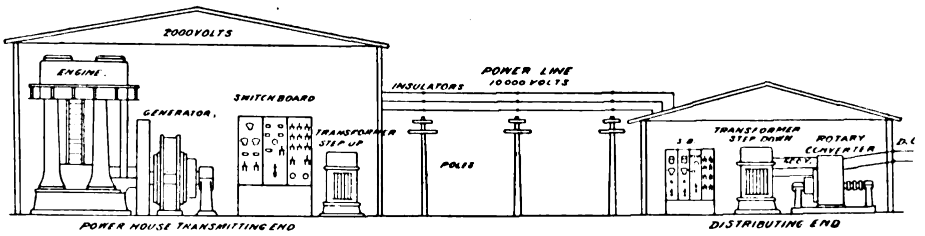
These might be included under the headings as follows:

Line	Resistance. Pressure. Insulation. Installation.

The resistance of the line largely determines the best pressure at which economical operation can be expected, or vice versa. The pressure determines the quality of the insulation and this and the other two the character and cost of the line as an installation.

Generating the Power.—The fact that a high pressure is necessary in developing useful power for transmission; that it must be transformed up or down, as the case may be, and that a commutator is absolutely out of the question for pressures beyond a certain point, leads inevitably to the conclusion that the only solution to this problem is to be found in the application of an alternating current. Here again a difficulty arises of a most important character The simple alternating current, though readily generated and transformed is hardly suited to the purposes ultimately held in view, namely, the transformation of electrical into mechanical energy. A simple alternating current motor, whose use in the conversion of alternating into direct or direct into alternating currents is so necessary, will not operate in its generally accepted form. Recourse is had to the two and three-phase alternating current for such purposes. These currents are serviceable in the use of self-starting economical motors for power transmission purposes. The power generated, therefore, must be in such a form that the accomplishment of the purpose in view can be successfully carried out.

Modern power transmission plants consist of a complete equipment consisting of two or three-phase alternators, step-up transformers, oil switches and either water power as an original source of energy or steam. The receiving or distributing end of the system holds step-down transformers and rotary converters. If the current is to be distributed simply as an alternating current useful for power purposes, no rotary is necessary. The essentials of a power house, and those of the distant end of the plant, are so related that the efficiency is preserved in every reasonable manner possible. Yet in spite of such precautions, the use of an alternating current, though absolutely necessary in power transmission, presents difficulties.



Elements of a power transmission plant for street railway service.

Use of Transformers.—The alternating current readily lends itself to the ready transformation of pressure up or down. The transformers stepping up the pressure or stepping it down are called "step-up" or "step-down" transformers. They serve the function in the power house of raising the pressure to the proper point for transmission. All of the energy enters them at one end of the circuit. Before it is handled for distribution it is sent through another set and "stepped down" to a safe pressure. The entire process, one very vital to the efficiency, is carried on in the following machines: In the engine or water wheel, in the generator, in the transformer, in the line, in the rotary converter and then into the city distributing lines. This may be represented in the following manner:

Power House.		Distributing Station.
Engine. Dynamo. Switchboard. Transformers, step up.	Line.	Transformers, step down. Rotary Converters. Street Lines.

If some estimate is made of the net results of the process from the standpoint of efficiency, based upon a general efficiency of 90 per cent. per machine throughout the plant, the figures would show a lower efficiency than would be anticipated at first glance. Taking 1,000 hp. in the engine, the dynamo would yield 900 hp., the switchboard and transformers 10 per cent. less, or 810 hp.; the line 10 per cent. less, or 729 hp.; the transformers 10 per cent. less or 656 hp., and the rotary converters and street lines, 10 per cent. less, or 590.4 hp.

Criticism could of course be justly made of this uniformly sweeping rating, but it serves the purpose in showing how a slight gain in the dynamo, transformers or line of distributing station will accrue to the benefit of the total efficiency. The erectors of our large plants claim higher percentages of efficiency than this, but a 30 per cent. loss is not to be considered as very large from end to end.

WRINKLES.*

EDITED BY H. C. ABELL.

Three-Wire Underground Services.

In making three-wire underground connections to buildings, either from pole line or underground conduit, run duplex rubber-covered, lead-cased wire, fore the outside wires, and bare copper wire, either stranded or solid, depending upon the size, for the neutral; all to be run in wrought-iron pipe, either red-leaded or asphalted inside and out. This makes a cheaper service connection than if the three wires were all insulated, and also helps to ground the neutral better than is apt to be the case where the only secondary grounding done is by digging a hole at the foot of the pole, where the soil may or may not be damp at all times.

P. C. Brown, Brookline, Mass.

A Scheme for Operating 1,100-Volt Series Incandescent Circuit from a 2,200-Volt Circuit.

Upon changing the primary voltage from 1,100 to 2,200 volts, the question came up of what to do with the series incandescent street circuits in one of the suburbs of Denver. To change these circuits to 2,200 volts would entail considerable expense and time. It was overcome as follows:

A tap was brought out from the middle point of the primary coil of a 4-kw., 1,100-

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*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

2,200-volt, shell-type transformer; the street circuits were connected between this neutral and the outsides, and balanced as nearly as possible. The 2,200-volt feed was connected to the two outsides. The voltage was found to be a little low on one side, so the circuits on this side were connected in series with the secondaries of the same transformer, and the voltage thus boosted. The balancing set, as it might be called, has been in operation for two years and has never given a particle of trouble.

J. F. Dostal, Denver, Col.

Transmission Line.

During the past year we contracted to furnish a large amount of power to a dredging company situated about 11 miles from our station. This power was transmitted at 11,000 volts, three-phase, 60 cycles and stepped-down to 370 volts and fed directly to a synchronous converter.

As the dredges were to be moved about considerably, we built a small wooden transformer house of sufficient size to hold three 50 kw. transformers and lightning arresters. This house was mounted on a wooden sledge and by means of a team of horses can be easily moved about. In order to allow the dredge considerable travel without necessitating the moving of the transformers, the secondary leads were brought out of one end of the transformer house in the shape of a single triple-conductor, rubber-insulated flexible cable. This cable lies on the ground and often lies partially submerged in water. In order to better protect the cable an ordinary fire hose of extra quality was slung on over the cable. This arrangement has now been in operation for about 8 months, and thus far it has given perfect satisfaction.

C. W. Humphrey, Denver, Col.

Home-Made Oil Switches.

A short time ago it became necessary to have some oil switches on short notice. We had some old air-brake feeder switches on hand, so we made some tin boxes, filled them with oil and put the old switches in the oil—the switches being placed in a horizontal position with handles at right angles—and led the high-tension wires in through porcelain tubes. This scheme was very satisfactory.

G. F. Willard, Denver, Col.

A Scheme to Bring Up Potential for Alternating Current Series Arc Circuits.

The tub transformer broke down, but we had six old transformers, so we connected the primaries of three of them in parallel across the mains, and the secondary of each was connected to the secondary of one of the other three, and the primaries of the last series were all connected in series to the arc circuit.

G. F. Willard, Denver, Col.

LIEGE ENGINEERING CONFERENCE.

(Special Correspondence of "Electricity.")

At the Liege meeting of the British Institution of Mechanical Engineers, held on June 20-23, some noteworthy papers were read. One was devoted to the subject of "Electric Winding Machines," and was prepared by Prof. Paul Habets of Brussels. Considerable attention was devoted to the dynamic investigation of haulage, and the starting properties of electric motors for haulage work. A full description was given of the electrically-driven winding machines at the pit of St. Nicolas at the collieries of Esperance & Bonne-Fortune, Montegnee, also of the results of a series of trials made, with the object of giving an account of the performance of the Ilgner system; also of testing the consumption guaranteed by the contractor, and of determining the consumption of energy under actual working conditions. The trials were made in January this year, and in Prof. Habets' opinion, it is safe to conclude from them that the electric haulage machine, even if it is not more economical than the best steam-driven machine, is certainly not more expensive. The greater facility and safety with which it can be manipulated, the smoothness with which it works and its much greater flexibility, will often make it preferable to the steam-driven machine, even in the case where transmission of energy is not required, and Prof. Habets says "there can be no hesitation in the choice between the two systems, when the power to be transmitted from a distance, or, as in the case of the pits of St. Nicolas, where the production of energy can be centralized at one power station."

Effects of Steam Jacketing.

One other paper read at the conference should have mention here. It consisted of an account of interesting investigations which have been made upon the experimental engine at the Municipal School of Technology, Manchester, Eng., by Mr. A. L. Mellanby with a view to determining the effects of steam jacketing upon the efficiency of a horizontal compound steam engine. The following is a summary of the most important results obtained:

Best Mean Pressure.—The compound engines with a boiler pressure of 150 pounds may be worked with a mean pressure referred to the low pressure cylinder of about 40 pounds per square inch without any loss of efficiency in terms of the brake horse power.

Maximum Efficiency.—That the jackets have their maximum efficiency when the whole of the high pressure and the ends of the low-pressure cylinders are jacketed with high pressure steam.

Variation of Indicated Horse Power.—That when the jackets are applied to the high pressure cylinder the total indicated horse power is slightly reduced, but when applied to the low pressure cylinder the total indicated horse power is considerably increased.

Initial Condensation.—That the jackets have little effect in the high-pressure, but have a considerable effect in the low-pressure cylinder upon initial condensation.

Temperature-Cycle of Metal.—That the temperature-cycle of the cylinder walls next to the steam must be considerably less than that of the steam.

1. Because the actual missing quantity is much less than it would have been had the steam and metal gone through the same temperature changes.

2. Because the mean temperature of the metal is higher than that of the steam.

Missing Quantity.—That the greater part of the "missing quantity" must be due to leakage and not to initial condensation.

1. Because the application of the methods suggested by Callendar and Nicolson shows the condensation to be but a small fraction of the total missing quantity.

2. Because the apparent re-evaporation during expansion is less for jacketed than for unjacketed engines.

Report of New York's Municipal Lighting Committee.

Messrs. Cary T. Hutchinson, Nelson P. Lewis and George F. Sever, the special committee appointed last fall by Mayor McClellan to prepare plans for a lighting plant to furnish all the public lighting for New York City, has submitted its report to the Board of Estimate. The committee estimates the initial cost for the acquisition of property and equipment of plant at $7,567,000. It places the operating expenses at $1,269,000 annually and the cost of each arc light at $64.07 per year, compared with $146 at the present time, while for incandescent service the cost is estimated at 5.5 cents per kilowatt hour, against 10 cents, the present basis. The committee points out several ways in which a material reduction can be made in the cost, in such a manner as to effect a saving of $1,481,000 annually to the city through the operation of its own lighting plant, or an amount equal approximately to 20 per cent. of the initial investment. The report was referred to Nelson P. Lewis, chief engineer of the board, and Controller Grout.

Alleged Discord in the American Institute of Electrical Engineers.

Leading members of the American Institute of Electrical Engineers ridicule the story published in the New York "World" on Sunday, "that revolt divides the Institute." The article in the "World" is as follows:

"There is dissension within the ranks of the American Institute of Electrical Engineers.

"The complaint comes from the members at large. It is said, sub rosa, that the Institute is no longer national in its scope, but has become a local affair, in that all the officers at present are interested in matters in the city of New York rather than in the country at large, and the plea among many members is, that the New Yorkers in the organization are running the society.

"'About the size of it,' said a member yesterday, who did not wish to have his name published, 'is that the highest offices in the Institute are being hogged right along by the New York City men. We fellows in the country are trying to get along without anything but hope. We think it is time to give us a show at other things. We don't want New York City to get it all.'

"Those posted as to the inner workings of the organization say that President Lieb has sought for some time to smother the revolt by striving to change the Institute's constitution so that the selection of nominees for office could be made by a committee that would have a membership representing the different sections of the United States.

"It is pointed out, however, by the dissenters that the Institute's existing constitution contains specific provisions for the geographical distribution of offices, but that these provisions have been flagrantly violated or deliberately ignored.

"'Another point to consider' said another member last night, 'is that New York members have time and time again been selected for high offices at the expense of out-of-town members, although they have received a smaller number of nominating votes than out-of-town members.'

"The feeling is so bitter that some of the outside members are talking of breaking away from their New York brothers and forming a new organization."

Electrical Contractors' Convention.

The fifth annual convention of the National Association of Electrical Contractors will open in Mechanics Building, Boston, on Saturday evening, July, 15. A reception committee will be at headquarters Saturday, Sunday and Monday, and will meet the specials due from New York and the West on Tuesday afternoon and evening.

The open session of the convention on Wednesday will be a notable event. Addresses of welcome will be delivered by F. L. Barnes, president of the Massachusetts State Association; by Governor Douglas in behalf of the State, and Mayor Collins in behalf of the city. E. McCleary of Detroit, Mich., president of the National Association, will then deliver the annual address, after which will come several other addresses.

An executive session of the National Association will be held Wednesday afternoon, and the annual dinner to the members of the National Association will be given in the evening. Thursday forenoon will be devoted to a session of the association. Friday will be given to executive sessions of the National Association and Saturday will be spent in sightseeing and entertainment.

New York Street Railway Association Convention.

The 23d annual convention of the Street Railway Association of the State of New York was held June 27–28 at the new Fort William Henry Hotel, Lake George. The meeting was called to order by the president, C. Loomis Allen of Utica, who gave an address of welcome, after which several interesting papers were read on practical subjects. H. W. Blake of New York held the close attention of the delegates during the reading of his paper on "Contrast Between Company and Municipal Ownership of Public Utilities." J. Harvey White of the Boston Elevated system presented a paper on "Publicity." The general programme was concluded by a question box conducted by C. B. Fairchilds.

The following officers were elected for the ensuing year: President, R. E. Danforth, Rochester; first vice-president, B. B. Nostrand, Jr., Peekskill; second vice-president, J. H. Pardee, Canandaigua; secretary, C. B. Fairchilds, Jr., New York; treasurer, William W. Cole, Elmira; executive committee, E. F. Peck of Schenectady, T. M. Wilson of Buffalo, Oren Root, Jr., of New York, and J. N. Shanahan of Gloversville.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JUNE 27, 1905.

Electric Railways and Appliances.

793,304. Trolley-Wheel and Guard Therefor. Fridolin Koenig, Newark, N. J., assignor of two-thirds to Charles Koenig, same place, and Fridolin Koenig, Jr., New York City. Filed Dec. 17, 1904.

793,312. Automatic Trolley-Pole. Alfred W. Morgan, Longbeach, Cal. Filed Jan. 30, 1905.

793,343. Car-Fender. Peter Best, Elizabeth, N. J. Filed Sept. 27, 1904.

793 344. Trolley-Base. Peter Best, Elizabeth, N. J. Filed Sept. 29, 1904.

793,430. Trolley. David C. Evans and Oliver O. Patterson, Uniontown, Pa. Filed March 15, 1905.

793,479. Switch for Electric Railways. Carl Voss, New York City. Filed April 1, 1905.

793,480. Electrically-Operated Railway-Switch. Bryan S. Wakeman, Scranton, Pa., assignor, by direct and mesne assignments to the Scranton Electrical Switch & Signal Company. Filed Aug. 30, 1904.

Electric Lights and Appliances.

793,211. Method of and Apparatus for Finishing Electric Lamps for Bulbs. George P. McDonnell, St. Louis, Mo., assignor to the American Electric Company, East Orange, N. J. Filed Nov. 9, 1904.

793,440. Arc-Lamp Yoke. Charles E. Harthan, Lynn, Mass., assignor to the General Electric Company. Filed Dec. 13, 1902.

Electrical Machinery and Apparatus.

793,066. Electric Switch. Monroe Guett, Hartford, Conn., assignor to the Hart & Hegeman Manufacturing Company, same place. Filed Nov. 1, 1904.

793,429. Electrically-Operated Hydraulic Valve. Carl Engberg, St. Joseph, Mich., assignor to the Engberg Electric & Mechanical Works, same place. Filed Feb. 23, 1904.

793,454. Multiple-Switch Rheostat. Frederick Mackintosh, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 5, 1903.

793,474. Brush-Holder and Brush-Holder Support. Leonard A. Tirrill, Lynn, Mass., assignor to the General Electric Company. Filed Nov. 28, 1904.

793,491. Maximum-Current Indicating Device. Maurice J. Wohl, Brooklyn, N. Y., assignor to the General Electric Company. Filed Nov. 21, 1904.

793,493. Rheostat. William C. Yates and Alexander M. Fenwick, Schenectady, N. Y., assignors to the General Electric Company. Filed Sept. 26, 1904.

793,570. Motor-Controlling System. Arthur C. Eastwood, Cleveland, O. Filed April 15, 1905.

Telephones and Telephone Apparatus

793,325. Noise and Lightning Arrester for Telephone-Wires. Alexander Stiles, Martinsville, Ind. Filed Nov. 10, 1903.

783,398. Telephone Service-Meter. Frank R. McBerty, Evanston, and James L. McQuarrie, Chicago, Ill., assignors to the Western Electric Company. Filed Nov. 19, 1902.

Miscellaneous.

793 063. Electrical Instrument. John J. Ghegan, Newark, N. J. Filed Jan. 27, 1904.

793,076-077-078. Anode and Cathode-Plate for Batteries, Harry C. Hubbell, Jersey City, N. J. Filed Oct. 3, 1904.

793,093. Battery-Grid. Henry C. Porter, Waukegan, Ill., assignor to the Vesta Accumulator Company, Chicago, Ill. Filed Aug. 19, 1904.

793,117. Storage-Battery Jar. Thomas S. Witherbee, Jersey City, N. J., assignor to the Witherbee Igniter Company. Filed March 12, 1904.

793,158. Electric Heater. Charles A. Rolfe, Adrian, Mich., assignor, by mesneassignments, to the Rolfe Electric Company, Rochester, N. Y. Filed Nov. 14, 1903.

793,188. System of Electrical Distribution. Charles M. Green, Lynn, Mass., assignor to the General Electric Company. Filed Nov. 3, 1897.

793,244. Electric Signalling System. Herbert B. Taylor, East Orange, N. J., assignor to the Advance Signal Company, Newark, N. J. Filed Sept. 1, 1904.

793,313. Insulator. Bertie B. Moss, Pekin, Ind., assignor to Leander G. Davis and Milton Hottel, Salem, Ind. Filed Feb. 1, 1904.

793,329. Relay. Herbert B. Taylor, Newark, N. J., assignor to the Advance Signal Company, Newark, N. J. Filed Dec. 4, 1903.

793,424. Electric Oven. Levitt E. Custer, Dayton, O. Filed 14, 1904.

793,445. Lightning Arrester. Thomas J. Johnston, Brooklyn, N. Y., assignor to the General Electric Company. Filed Nov. 8, 1901.

793,513-514. Circuit-Controlling System. Arthur C. Eastwood, Cleveland, O. Filed Dec. 19, 1904, and April 15, 1905.

THE TELEPHONE WORLD.

Keystone Telephone Company's Bonds.

Fisk & Robinson are the head of a syndicate of New York and Boston bankers who have recently underwritten an issue of $4,000,000 5 per cent. 40-year coupon or registered bonds of the Keystone Telephone Company of Philadelphia. The bonds were issued for the purpose of retiring the company's floating indebtedness and to provide funds for development work. This issue is the first lot of bonds which has been put out and constitutes a first lien on the property of the company.

The company has a perpetual franchise and has outstanding $6,000,000 common stock and about $2,000,000 6 per cent. cumulative preferred stock. The bonds will be sold largely in Philadelphia and New York. Such bonds as are to be sold in Boston will not be offered to investors until some time in the early part of July.

At a recent meeting of the Vallejo, Cal., city board of trustees, Attorney Frank R. Devlin, of that city, filed a petition asking that the board advertise the sale of a franchise to maintain through the streets of Vallejo for the period of 50 years a telephone system. Mr. Devlin refused to disclose his plans, but says that the new company will install a system on the lines of the new "Home" telephone system. It is believed the new $4,000,000 incorporated company, composed of the most prominent capitalists in San Francisco, is behind Mr. Devlin and intends to build in cities other than San Francisco. The Pacific States Telephone Company is preparing to meet the new line by spending nearly $20,000 to entirely rebuild the Vallejo system.

The People's Line Telephone Company, of Ontario County, held its annual meeting in Canandaigua, N. Y., last month and elected the following named officers for the ensuing year: President, Hector W. Blake, Naples; vice-president and general manager, John Litzendorf, Honeoye; secretary, George B. Hemenway, Naples; treasurer, George R. Granby, Naples; directors, D. O. Pierpont, Richmond; E. C. Church, Canandaigua; R. B. Abbey, Richmond.

The Sleepy Eye, Minn., Telephone Company, recently organized with a capital of $25,000, has begun active work in extending lines through that section of Brown County. It has completed one line running south of Sleepy Eye to Lake Hanska, about 15 miles.

Articles of association were lately filed by the Holton, Mich., Rural Telephone Company. The capital stock is $5,000. Herbert O'Connor owns 498 shares, and his brothers, Herman and Wiley, one share each,

The Harrah, Okla., Telephone Company is a newly organized concern capitalized at $5,000. The incorporators are Karl Haas and Marion Platt, of Harrah; J. W. Stephens and W. G. Henderson, of McLeod.

The Imboden, Ark., city council at its last meeting granted a 50 years telephone franchise to M. H. Long.

Government Pays Smallest Price for 'Phone Service.

As a result of the investigation into the Government telephone service in Washington, made by Secretary Morton at the instance of President Roosevelt, a new contract has been made, which will amount in a saving on the business for the fiscal year of 1905-6 of $17,635.

Secretary Morton in reporting to the President on the result of the negotiations for a new contract for departmental telephone service in Washington, states that the rate given the Government in Washington, "is the lowest telephone rate in existence in any large city in the United States."

A reduction in the rental of stations in private branch exchanges from $12 to $6 a year is announced, and a reduction in the message rate from 3 cents to 2½ cents has been secured. Considerable economies have been accomplished in wire rental.

The total amount it is expected the Government will pay to the company during the coming year is $47,562.

Independent Telephone Deal.

An important deal in the Independent telephone situation in Northwestern Iowa has lately been concluded, which involves the absorption of all the toll lines, rural lines and local exchanges belonging to the Monona Telephone Company of Onawa by the New State Telephone Company of Sioux City, a millon-dollar corporation recently formed to conduct the toll business in connection with the new automatic telephone system being installed in Sioux City, the service for which will be ready by the middle of this month. The stockholders of the Monona Telephone Company accept $60,000 worth of stock in the new State Company. Sixteen towns are on the list. The new State Company now owns all of the Independent telephone lines and local exchanges within a radius of 50 miles of Sioux City, including 15,000 'phones in all. Copper trunk lines are being built to Le Mars, Correctionville, Sioux Falls, Yankton and Fremont, Neb.

The Lake Champlain Telephone & Telegraph Company was recently incorporated with the Secretary of State to operate lines from Eagle Bridge through Rensselaer, Washington and Essex Counties in New York, and Bennington, Rutland and Addison Counties in Vermont. The capital stock is $250,000, and the directors named are Henry E. Hawley, of Albany; J. N. Keller, F. A. Houston, C. T. Keller and F. W. Story, of Boston, Mass.; O. A. Dennis, of Whitehall, and E. D. Raymond, of Fair Haven, Vt.

Some 30 'phones are now installed on the rural system between Strawberry Ridge, Jerseytown, White Hall and Exchange, Pa., and although connection is not yet established with the United system the subscribers are enabled to talk with each other over the wide territory embraced by the above-named towns.

Steps looking toward the extension of the telephone system to include the towns of Tracyton, Silverdale, Wash., and terminating at Brown's Bay, are being contemplated. Negotiations are in progress with Manager W. D. Colder, of the Peninsular Telephone Company.

Syndicate Buys Telephone Company.

A syndicate formed by the Mississippi Valley Trust Company has purchased the Suburban Telephone Company, operating in St. Louis County, Mo., within a radius of five miles from Clayton. The lines will be increased to include all of St. Louis County. The intention of the new controlling interests are to increase the capital stock from $100,000 to $500,000,

The price paid for the stock of the Suburban Company has not been made public. A working agreement is planned to be made between the new company, which will be Independent, and the Kinloch Telephone Company.

James Houseman, original promoter of the Suburban Company, and a principal stockholder, closed the deal for the sale. Stockholders from the Suburban and Kinloch companies are included among those interested.

Consolidated Company Increases Directorate.

The Consolidated Telephone Company, which recently acquired the stock of the Frontier Telephone Company, of Buffalo, N. Y., has increased its directorate by electing the following men: John Markle, Wilkes-Barre, Pa.; J. Sloat Fassett, Elmira; E. Frank Brewster. Rochester; George W. Thayer, Rochester; V. Moreau Smith, Rochester; Charles W. Goodyear, Buffalo.

Coloma, Cal., is to have a local telephone system. Business has increased to such an extent that the telephone company has seen the need of additional service. The preliminary steps have been taken and the new line, it is expected, will be in full operation in a short time.

The Highways Commission of Maryland, has granted permission to the Chesapeake & Potomac Telephone Company to build a line from White Hill to Bluemont, and from Herford to Mount Carmel. When this is done the telephone company will have extended its lines to every section of Baltimore County.

The Home Telephone Company, of San Francisco, Cal., stands ready to spend millions of dollars in constructing an up-to-date plant the moment permission is granted it for a city franchise.

The Independence, Mo., Home Telephone Company has filed notice of an increase of its capital stock from $30,000 to $60,000.

The Auglaize County, O., Telephone Company has increased its stock from $15,000 to $25,000.

Telephone Incorporations.

The German Telephone Company, Craigville, Ind. Capital stock, $10,000. Directors: John H. Barger, William H. Deihl, Alfred S. Abbott, Walter Reed and David C. Huffman.

The Automatic Telephone Manufacturing Company, Augusta, Me.—to manufacture telephones, etc. Capital stock, $200,000. President, L. J. Coleman, Gardiner; treasurer, W. S, Lee; clerk, C. L. Andrews, both of Augusta.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Aledo, Ill.—Bolton Brothers have been granted a franchise to operate an electric light plant here.

Alma, Kan.—It has been reported that this city is to have an electric light plant to be installed in a few months.

Bellevue, O.—The Mutual Light & Water Company will be the name of the new company granted a franchise to light the streets of this city by electricity. Its capital stock is $50,000, and incorporators, E. C Crocker, B. F. Bell, Peter Brady, W. H. Bell and C. W. Bell.

Cairo, N. Y.—The Cairo Electric Light & Power Company, capitalized at $50,000, has been formed with the following directors: C. E. Hewitt, M. G. Hubbard, Chatham, N. J.; F. G. Walters, Cairo.

Carbon Hill, Ala.—The citizens have voted to issue bonds to put in a waterworks system and electric lights.

Center, Tex.—The electric light plant here was lately destroyed by fire.

Coalgate, I. T.—The Coalgate Electric Light & Power Company has been incorporated with a capital of $100,000.

Dayton, Ia.—The citizens have organized a light and power company, with a capital of $10,000, and will install an electric light plant.

Friar Point, Miss.—A committee composed of J. H. McClelland and O. G. Johnston, was lately appointed to correspond with sundry firms to ascertain the cost of installing an electric light plant in this town.

Galva, Ill.—This town will issue $5,000 in bonds to build a new police station and extend the electric light service.

Kennewick, Wash.—C. R. Wood, of Genesee, has asked for a franchise for an electric light and water system for this city.

Kingsley, Mich.—Business men of this village are considering a plan whereby they can secure electric lighting for the business places and streets of this village. It is proposed that they shall install poles and lamps, and the Boardman River Electric Light & Power Company furnish the current from its plant.

Little Falls, N. Y.—At a recent special meeting of the common council, the matter of the street lighting contract was taken up. Attorney Rush F. Lewis asked that a franchise be given the Hudson River Electric Power Company to operate in this city. The matter was placed in the hands of a committee with full power to investigate and appear at a subsequent meeting of the board. The committee consists of Mayor Douglas, Aldermen Staus, Dettinger, Livingston, Ash, Walrath and Jennings.

Quincy, Ill.—At the annual meeting of the Quincy Gas & Electric Company it was voted to increase the capital of the company from $600,000 to $2,000,000. The officers are K. I. Lynn, president; M G. Borgmah, treasurer.

Scottsbluff, Neb.—Charles Johnson, of Iron Mountain, Mont., says he will put in an electric light plant either here or in Gering if he can get enough renters to sign a contract promising not to rent of any other person or party for at least five years.

Snohomish, Wash.—The Snohomish electric light plant was totally destroyed by fire, entailing a loss of $10,000.

South St. Paul, Minn.—The South St. Paul Electric Light, Heat & Power Company has filed articles of incorporation with a capital of $50,000. The incorporators are Michael O'Toole, Emil Gardie and others.

St. Augustine, Fla.—The city council has accepted a bond for $5,000, furnished by T. R. Osmond and W. D. Barnett, as a guarantee for the construction of an electric light plant and street railway.

Tecumseh, Neb.—This city will increase the capacity of its electric light plant.

Temple, Tex.—O. W. Jones, of Oscar, located seven miles east of this place, has been here making arrangements for installing an electric light and telephone plant at Rogers, 15 miles south of this place on the Santa Fe. Mr. Jones and his associates will build an up-to-date electric light plant. They will likewise build a first-class telephone exchange and furnish local service not only to the town of Rogers, but to a large section of fertile farming country extending around it.

Van Horn, Ia.—A new electric light plant will soon be installed here with 1,000 lights capacity. O. H. Hartung and John Holler are at the head of the enterprise.

Webb City, Mo.—The Southwest Missouri Electric Light Company has asked the city council to grant a franchise for it to furnish this city and its citizens with lights and power.

Winfield, Kan.—An electric lighting plant, to cost $45,000, will be installed here soon.

STREET RAILWAYS.

Barberton, O.—The Barberton, Wadsworth & Western Traction Company was lately granted a franchise for 25 years to operate its line over three of the county roads.

Carlisle, Pa.—It is said on reliable authority that the Dillsburg branch of the Cumberland Valley Railroad, running from Mechanicsburg to Dillsburg, will soon be operated by electricity, making hourly communication to Harrisburg by connection with the Valley Traction cars at Trindle Springs.

Indianapolis, Ind.—A company of Dayton, O., electric road builders and financiers have been making arrangements for the building of an electric road from the army post to the end of the College avenue city line.

Jacksonville, Fla.—W. A. Riddle and J. D. Lawrence, of Philadelphia, will build an electric railroad from this city to St. Augustine.

Lansing, Mich.—The Lansing City Electric Railway Company, through a communication from Superintendent James R. Elliott, has accepted the franchise granted it by the council.

Marietta, O.—The work of taking up rights of way for the extension of the electric line from Devol's Dam to Lowell will begin at once.

Millville, W. Va.—The Winchester & Washington City Electric Railway Company of Winchester, Va., has purchased a site here upon which a large power house will be erected.

Newport, Ky.—A traction line to connect the localities of Brent, Phoenix Grove, Glen Park, Melbourne and Ross, and give rapid transit communication with this city, is being agitated by the residents of the places named.

North Yakima, Wash.—This city is to have an electric railway system to tap the valleys that are tributary to it.

Riverhead, N. Y.—The officers of the Pennsylvania Railroad, operating the Long Island Railroad system, are said to be considering the construction of a new trolley line running from Wading River to Mattituck, a distance of 18 miles. The proposed route has been surveyed. The line would run through the northern part of this village and parallel Long Island Sound for several miles, connecting the Wading River branch of the railroad with the main line.

Schenectady, N. Y.—Extensions of the trolley lines will be built in this city.

POWER PLANTS.

Charleston, S. C.—Plans are said to have been nearly perfected for the development of the water power at the Great Falls on the Catawba River, near Chester and Winnsboro. The promoters of the project have secured possession of the properties on the river at that point for a distance of eight miles, in which there is a fall of 173 feet. This power will be developed in units one-third its total capacity. Each unit will give from 25,000 to 30,000 hp. The main line from this point will transmit the current at 44,000 volts.

Galion, O.—The Crawford Gas & Electric Company, recently organized by local and Eastern capital, is preparing to erect an up-to-date electric power house to cost about $75,000 to furnish electric power for manufacturing and other purposes in this city. The company will also furnish light and power to all neighboring cities with which it can secure contracts, the service to be furnished from the plant in this city.

Housatonic, Mass.—To develop 1,000 hp. on the Housatonic River in Glendale and Stockbridge, the Monument Mills Company, of this place, will spend $100,000. A dam 200 feet long and 25 feet high will be built, and half a mile below will be a power house.

New York City.—The Kings County Electric Light & Power Company is to double its total authorized capital stock. To this end a special meeting of the stockholders has been called for July 10 to vote on a proposition to increase the capital of the company by $5,000,0000 to $10,000,000. W. W. Freeman has been elected vice-president and general manager in place of the late E. A Leslie.

BIDS WANTED.

Astoria, Ore.—Captain Goodale, Constructing Quartermaster, United States Army, of this place, will receive bids for electric light fixtures, and for the installation of an exterior and interior lighting system at Fort Stevens.

Omaha, Neb.—Sealed proposals in triplicate will be received for an electric lighting system at Fort Crook. Address Major M. Gray Zalinski, Constructing Quartermaster, Army Building, Omaha, Neb.

Washington, D. C.—Sealed proposals will be received until July 18 by C. F. Larabee, acting commissioner of Indian Affairs, this city, for furnishing electric light and constructing an electric lighting system at the new school near Wahpeton, N. D.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15@15⅛c.; Lake 15@15¼c.; casting, 14¾@14⅞c.

A dividend of 1¾ per cent. will be paid on the stock of the Consolidated Traction Company of New Jersey on July 15.

The Independent Telephone Company of Syracuse, capital $1,000,000, has been incorporated to operate in 16 counties of central New York.

The Omaha Electric Power Company has declared a dividend of $2.50 per share, payable August 1 to stock of record July 20.

The adjourned special meeting of the Mexican Telephone Company at the Astor House, New York, was again adjourned to July 19 at 10:30 A. M.

The Kings County (Brooklyn) Electric Light & Power Company stockholders meet July 10 to vote on a proposition to increase the capital from $5,000,000 to $10,000,000.

The New York & New Jersey Telephone Company has declared the regular quarterly dividend of 1½ per cent., payable July 15 to stock of record July 5.

The latest earnings of the Philadelphia Rapid Transit Company show that it closed the fiscal year, ending June 30, with an increase in net earnings over 1904 of about $270,000.

Plans for an immense holding company, which will take over all the electric traction lines centering in Indianapolis, Ind., are being made by the Widener-Elkins Syndicate of Philadelphia.

A schedule has been filed with the referee in bankruptcy showing the liabilities of the National Electric Company of Milwaukee, Wis., to be $1,259,671; assets, $3,500,000. Of the liabilities, $1,120,000 is secured.

There has been placed on record at Newark, N. J., a mortgage for $3,000,000 from the Morris County Traction Company to the Trust Company of America of New York, as security for an issue of bonds to be used in extending the lines of the Traction Company in Morris and Union Counties, N. J.

The General Transmission Company of Buffalo, N. Y., recently filed a mortgage of $15,000,000 on its property to the Buffalo Loan, Trust & Safe Deposit Company. The object of the mortgage is to enable the company to issue bonds. The company operates an electric system and gets its power from Niagara.

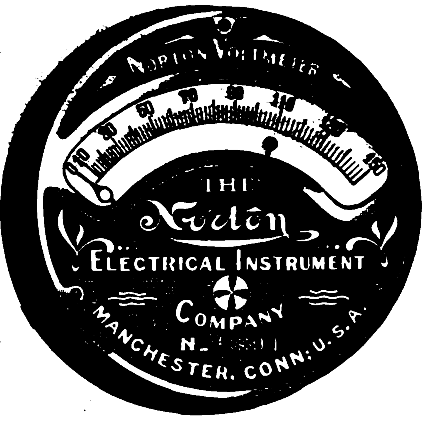
The reorganization committee has recommended a sale of the Eastern Ohio Traction Company's property under foreclosure of the consolidated mortgage, and the organization of the Cleveland and Mahoning Valley Traction Company to take over the properties, to manage which the Eastern Ohio was organized in 1902. The proposition is to issue $2,000,000 common, $1,000,000 preferred, and $2,500,000 new first consolidated mortgage 5 per cent. bonds. The new company will need $878,000 for various purposes.

The National City Bank of New York and N. W. Harris & Co. have jointly purchased direct from the company, and are offering to investors, $3,250,000 of first mortgage 5 per cent. gold bonds, due December 1, 1948, of the New York Gas and Electric Light, Heat & Power Company. With the purchase of these bonds the entire issue of $15,000,000 is now outstanding. The New York Gas and Electric Light, Heat & Power Company was consolidated with the Edison Electric Illuminating Company in 1901, thus forming the New York Edison Company, practically the entire capital stock of which is owned by the Consolidated Gas Company of New York.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price July 1.
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	200¼
Manhattan Elevated Railway	165½
Metropolitan Street Railway	127¾
Metropolitan Securities	83¼
Ninth Avenue	197
Third Avenue	131
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	71⅜
Brooklyn City Railway	239
New Orleans Railway	..
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	83¼
Philadelphia Traction	100
Union Traction	59¾
Boston.	
Boston Elevated	157
Massachusetts Electric Companies, com	18¼
do. do. do. pref.	63
West End Street, com	98
do. do. do. pref.	114¼
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	6
do. do. pref.	38
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	15⅝
do. pref.	51⅝
Electric Boat, com	34
do. do. pref.	75
Electric Lead Reduction	¼
Electric Vehicle, com	17
do. do. pref.	21
Westinghouse, com	167¼
do. pref.	190
General Electric	176¼
Boston.	
Edison Electric Illuminating	245
General Electric	176
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	160
National Carbon, com	67
do. do. pref.	118
Philadelphia.	
Electric Company of America	11¾
Electric Storage Battery, com	76
do. do. do. pref.	76
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	140
Western Telephone Company	17¾
New England Telephone Company	188¼
New York.	
American Telegraph & Cable Company	90½
Commercial Cable Company	210½
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	172¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93¾
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Otis Elevator Company	60
Consolidated Car Heating	64
Standard Underground Cable	

NORTON SWITCHBOARD INSTRUMENTS.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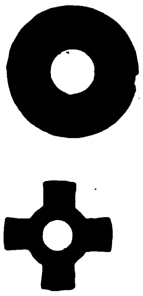

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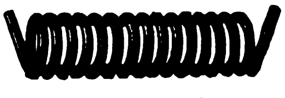

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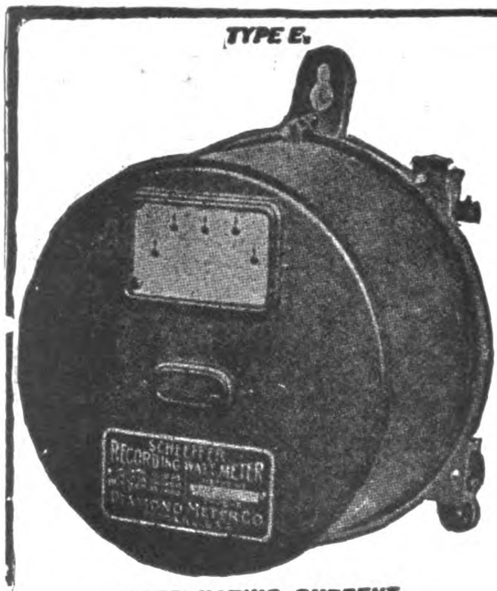

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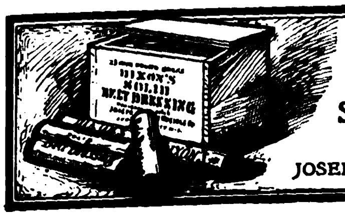

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EDITORIAL NOTES.

What Electricity is Doing for Long Island.

The artificiality of city life must give way periodically to the imperative demands for fresh air and freedom. Recuperation is so great a necessity that a denial of this requirement leads to physical bankruptcy. In certain respects, Long Island has been the camping ground for tired and anaemic citizens for many seasons. It is endowed by nature with many advantages that have led to its exploitation as a place for winter and summer homes; but a most valid objection was raised and has been raised for many years by prospective settlers. The transportation facilities were regarded as part and parcel of a system touching upon the archaic. Condemnation, however varied and profuse, led to but temporary improvements. Long Island, for these and other reasons of a secondary nature, developed in a sluggish and unsatisfactory manner. Its enormous stretches of snow-white sand remained deserted. Even if such spots were accessible, the fare was prohibitive to those with whom economy was dictated by necessity. This is the situation to-day, at a time which might be practically regarded as the dawn of a new era in the history of Long Island. This new era was inaugurated in 1905 by the laying of a third-rail and the bonding of tracks to certain crowded sections of this island of summer homes. It has rarely happened that the introduction of electricity for such purposes has failed in its accomplishment. It means the thin edge of the wedge, the beginning of great changes in transportation facilities. Electricity is making Long Island a near-by suburb of New York. This not only means civic stimulation of the healthiest character, but it supplies an outlet on the east for the population of a city whose only line of expansion hitherto was northward. It brings health resorts within a reasonable time of New York, and under such circumstances by increased traffic will probably lead to a reduction in rates. Now that progress is the watchword, the electrification of Long Island will represent one of the most interesting phases of third-rail traction in the United States. It is one of the most substantial methods possible of opening up a territory suitable in every respect to the peculiar needs of Greater New York from the double standpoint of expansion and hygiene.

The Bronx is getting its subways, and already possesses elevated roads and surface cars. These are remedies which quickly alleviate certain of our city complaints. A little touch of the same medicine would rapidly transform Long Island into the scene of growth and improvements second to none in the entire country.

* * *

China and Our Electrical Industries.

If the spirit of change is causing a national ferment in China, as it did in Japan, then the opportunities for commercial and industrial development there are far greater than anywhere else in the world. The population of this comparatively untouched corner of the globe exceeds 500,000,000 people; and it is merely necessary to glance over the possible needs of this enormous community—when awakened to the same conditions of activity as Japan—to see what may be done along the lines indicated. Exclusiveness has never led to greatness in a national sense, and it may be stated now, with much of truth, that the leaven of change is disturbing the inner and more conservative circles of Chinese life as never before.

The rapid decay of Russian assumptiveness before the mailed hand of Japan hes moved this national anachronism to accept a broader view of Western civilization, if for no other reason, for that at least, of emulating her neighbor's example in acquiring to some degree, a knowledge of our arts and sciences. China is nothing more nor less than an overgrown nation, which will in the course of time become more and more susceptible to Western influence. This influence is bound to grow, and will, in the natural course of events, lead to a rehabilitation of her policy in internal as well as external affairs. The potentiality of this great aggregation of human beings, with their multifarious needs, has struck the average American with great force. The awakening of China means an industrial activity in this country which will be beyond easy measure.

Electrical equipments, such as those required for electric lighting, power and street railway service will be in the greatest demand. It might be said that England is on the ground now and will control the trade. The answer to this will be found in the following incident: When England advertised for bids for electric elevators for her subways, the contract was obtained by Americans because of their lower price and quicker delivery. The same has been true in connection with contracts in Soudan for steel bridges or in South Africa for railway equipments. China must call for these supplies and outfits and none can deliver them with the same celerity as ourselves. For this reason, the future prospects of radicalism in China are in many respects the future prospects of increased trade in this country. In spite of the Dowager Queen the growth of a definite public opinion in China is increasing. Newspapers of a reform character are beginning to circulate widely, and there is every reason to believe that the inner heart of Chinese conservatism will soon be pierced. So auspicious an event as this will be best recognized by a flood of orders from the Celestial Kingdom. Americans have a matter calling for their most careful consideration in dealing with this new problem in our international relations. They want China's trade, but some of our California friends don't want her people. It looks as though the near future will soon decide as to whether we will have both or none.

◆

The contract for the construction of the United Engineering Building on west 39th street has been awarded to Wells Brothers' Company of this city for $795,000. This does not include any allowance for steam heating plant, electric wiring, etc. The ground is already excavated and work will begin at once. It is expected that the edifice will be completed by October, 1906.

◆

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The prominent peak, Eismeer, on the Jungfrau railway in Switzerland, which is destined to rank as the highest railway station in the world, has just been reached by the successful piercing of a tunnel on the new line 1,500 yards in length. The Eismeer station is 13,400 feet above the sea, and 100 feet above the magnificent glaciers on the south of Mont Eiger. The station will be open for traffic in August and will make an incomparable starting point for glacier excursions and ascents.

◆

The North-Eastern Railway Company of England has adopted on a short stretch of road the "Hall" signaling system. In this system carbonic acid gas is made use of. The gas is contained in a cylinder at a pressure of 600 pounds to the square inch (reduced to 500 pounds working pressure), and the valves for admitting the air to the operating cylinder are electrically controlled.

◆

According to statistics during 1904, Great Britain sent $222,485 worth of electric apparatus and machinery to Egypt as against $25,855 imported from the United States. Our electric exporters should improve upon this.

◆

One of the most severe storms of the year swept over Greater New York last Monday afternoon. In ten minutes 1.2 inches of rain fell. Lightning and wind accompanying the storm played havoc in many places.

◆

Mayor Dunne has informed the Chicago City Council of his plans for municipal ownership of traction properties. It was not municipal ownership exactly, either, but, as the Mayor explained, the nearest thing possible under existing conditions, and he asked the aldermen to consider it carefully. Absolute municipal ownership and operation, the Mayor said, he does not consider practical just now. The plan which the Mayor offered in the first message he sent to the council since his inauguration provides for "the incorporation of a company, managed by five men who command the confidence of the people of Chicago, for their personal integrity, their business ability and their pronounced sympathy with the policy of municipal ownership. To this company is to be granted a 20-year franchise covering the streets in which the rights of the old companies already have expired, or will soon expire. It is to be stocked to the amount necessary to establish a street car system in these streets roughly estimated at 240 miles. No bonds are to be sold. The stock is to be deposited with a trust company which the five directors are to select so as to prevent a purchase of it and consequent control by outside interests."

◆

The necessary license has been granted by the Government of India to the Brush Electrical Engineering Company to supply electricity to the town and island of Bombay for lighting and power purposes. Two years are allowed for the laying down of cables in the principal portions of the city. The company has proceeded with the installation of the plant, while the Government has been considering the question, and during the past year several miles of cable have been laid down, and a generating station erected.

◆

High-speed trials with steam locomotives on the military railway between Marienfelde and Zossen in Germany, have been continued during the past few months with a 2.4 coupled express engine, superheated on the Schmidt system, and weighing, all told, 85 tons, of which 35 tons represent the four-axled tender. Coupled to three corridor cars, the engine covered the measured course at a mean rate of 84½ miles an hour, and drawing twice that number of cars at the rate of 80 miles per hour. The superheated steam locomotive employed on the Government railway lines has developed a speed of about 62½ miles an hour. The trials have shown that this type of engine is more powerful than the usual type of express locomotive, in that it can cover greater distances without changing, and is more economical in coal and water consumption.

◆

The Brooklyn Rapid Transit Company is about to introduce an elevated school car for the instruction of elevated trainmen. The car has been specially built for the purpose. It is 50 feet in length and has end vestibules, and sliding doors at each end with a pneumatic buffer, the doors being controlled by air. The car is thoroughly equipped with all sorts of electrical devices and is up-to-date in every particular. The interior is fitted up with sectional apparatus and a full train of six cars is shown in the motor equipment and air brake appliances. Both the drum type and switch group type of control are shown as well as the manner in which automatic couplings are made. This car will be in operation on or about the first of the coming month.

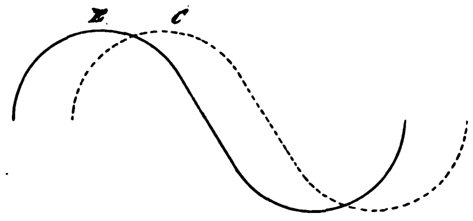
◆

ELECTRICITY LEAFLETS.

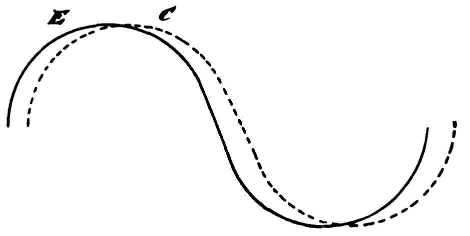
BY NEWTON HARRISON, E. E.

The Transmission of Power.

Effects of Frequency.—The effect of high or low frequency upon the capacity of a line to conduct a given amount of energy has led to the adoption of as low a frequency as is consistent with a continuity of flow. It is also evident that the question of resistance is secondary in circuits carrying a current of high frequency. The inductive resistance is the limiting influence in all cases where a high frequency is employed. The frequency is generally from 50 to 120 cycles per second in electric lighting. The effect of increasing the frequency is to make the copper conductor become inoperative. The cross-section of the conductor is not permeated by the electrical energy. It passes along the outer surface more and more as the frequency is increased, until at very high frequencies a thick copper bar becomes absolutely non-conductive to that particular form of energy Low frequencies in power transmission plants are necessary features if conductivity and efficiency are important considerations. The effects of the static capacity of the line and its inductance increase with the frequency. The sketch shows how the current and pressure become separated by the effects of induction and frequency. The development of a form of energy which is ineffective or *wattless* is readily discovered when the above conditions are exaggerated.

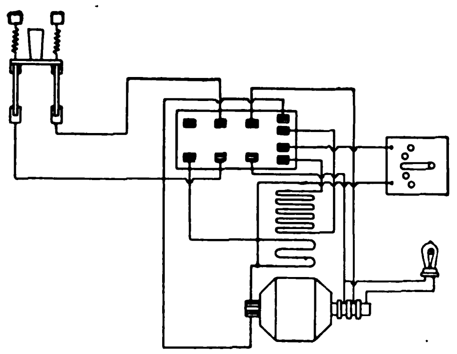


Effects of high frequency and induction separating C and E.



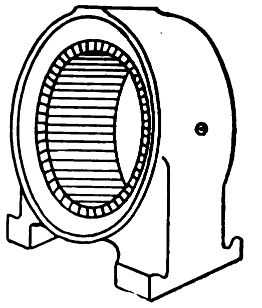
Low frequency, causing a better co-operation of C and E.

The Synchronous and Induction Motor.—The alternating current in its simple form, single-phase, as it is called, will not start an alternator to be used as a motor, from a condition of rest, unless it possesses the same number of poles and is speeded up until it is in step with the alternator. The motor and alternator are then said to be in synchronism but, as has been stated, to rise to synchronism, the alternator serving as a motor must be speeded up. Devices have been employed to serve this purpose, consisting of either means to split the phase and thus develop temporarily the effects of a two-phase current, or to use a commutator and series winding on the armature and field respectively. In this latter case, the alternating current serves to operate a series motor through the medium of the commutator and winding; then, when the requisite speed is secured the alternator is employed entirely as a synchronous motor.

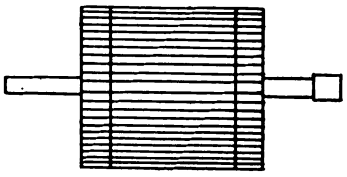


Synchronous motor, made to be self-starting by commutator and series field winding.

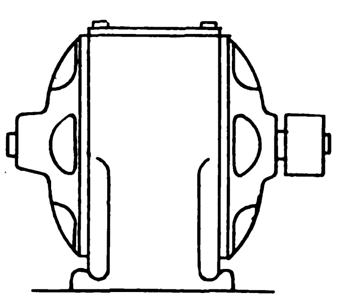
The induction motor operated by a two or three-phase current, is self-starting. It consists of a field so constructed that the two or three-phase current creates within it all the effects of a rotating wave of magnetism. A laminated iron armature, around whose periphery are set copper bars parallel to the shaft, will start itself from a condition of rest when exposed to the influence of the rotating field. The series wound motor has recently risen to prominence as serviceable for railroad purposes in connection with single-phase alternating currents. Their construction on a large scale will have a great influence on power transmission plants in that they remove the necessity for the conversion of the power into a direct current. It can be transformed down to a pressure suitable for railroad service and need not be generated as other than a single-phase current. Experiments performed in this direction give great promise of future usefulness. The series wound motor employed for this purpose is constructed in all essentials like a direct current machine but particular attention is paid to the induction. This is regulated by the design to meet the conditions of practice.



PRIMARY READY FOR WINDING



SECONDARY COMPLETE



MOTOR COMPLETE

Induction motor, showing primary ready for winding, rotor or secondary, and the machine assembled.

Effects of Inductance.—The general effects of inductance are such that impedance is manifested primarily, the consequences of which are a limitation in capacity of the circuit for the conveyance of power. The idea is well exemplified in the case of a choke coil connected to a lighting circuit. The choking effect becomes more and more magnified as the inductance in the coil is allowed to increase. The increase in induction causes a greater and greater separation between the two elements power, namely, the volts and amperes. The diminution in power as this difference is augmented, brings clearly to view the meaning of the power percentage factor or power factor. The apparent power and the available power, when compared as a ratio, show the contraction of the line electrically. In great power lines this fact is a controlling influence in their calculation and operation. Frequency and inductance may be considered as the modifying elements in power transmission by alternating currents.

Varying the Power Factor.—The variation of this factor is shown by changes in the relationship between the EMF. and current. These variations are due to the difference in phase between one and the other. If it is supposed that the EMF. and current represent the sides of an angle; then the more nearly the sides coincide, the less is the difference between the apparent and real power available The more widely they diverge, the less actual available energy is at hand. The angle is called φ according to the general notation and in a mathematical way the expression reads—the watts are equal to $E \times C \cos \varphi$, where the relationship between E and C as affected by the frequency, capacity and induction is shown by the cosine of the angle.

The Wattmeter.—The power measurement cannot be made by an alternating ammeter and voltmeter for the obvious reason that these instruments take no cognizance of the difference of phase. The wattmeter, however, is contrived to meet this requirement and gives readings of the true watts. The diagram showing how this purpose is attained is given in the following sketch. There is shown a movable coil and a fixed coil. The movable coil is placed as a shunt across the terminals when the meter is used. It has in series with it a non-inductive resistance. The fixed coil is placed in series with the circuit. Under these conditions the instrument has two currents operating in such a manner that the force required to hold the movable circuit with its axis at right angle to that of the fixed coil, will be proportional to the product of the mean value of the currents respectively. In other words, the wattmeter gives the net result of the power in the circuit. The conditions of success, as given by Prof. J. A. Fleming for the operation of a wattmeter, are covered by the following statement: "The current through the series coil of the instrument must have the same value as the current through the circuit to be measured, and the current through the shunt coil of the wattmeter must be exactly in step with the difference of potential between the ends of that shunt circuit; in other words, the shunt circuit must be strictly non-inductive. This can only be secured by winding the movable coil of the wattmeter with no very large number of turns. It is convenient to call the product of root—mean—square value of the amperes and the root—mean—square value of the volts, the *apparent* watts taken up by the circuit, and to call the true mean value of the power as read by the wattmeter the *true watts* taken up by the circuit."

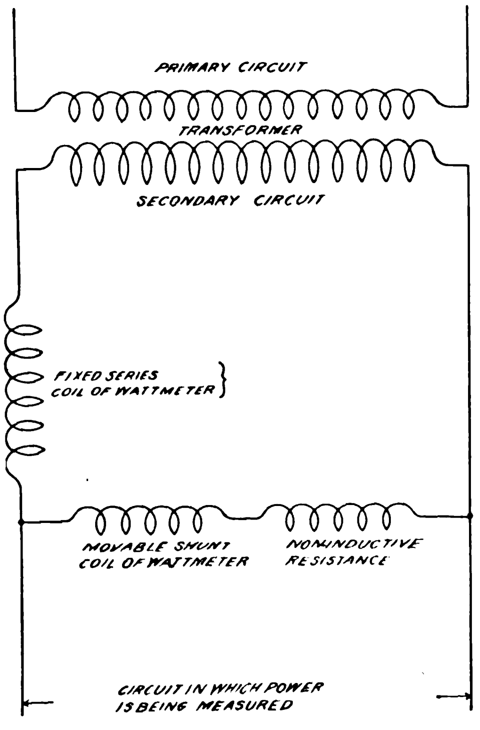

PRIMARY CIRCUIT
TRANSFORMER
SECONDARY CIRCUIT
FIXED SERIES COIL OF WATTMETER
MOVABLE SHUNT COIL OF WATTMETER
NONINDUCTIVE RESISTANCE
CIRCUIT IN WHICH POWER IS BEING MEASURED

Diagram of the essential parts of a wattmeter.

TABLE OF THE COSINES OF ALL ANGLES FROM 0 TO 90 DEGREES FOR CALCULATING POWER FACTORS.

Angle	Cosine	Angle	Cosine	Angle	Cosine	Angle	Cosine	Angle	Cosine	Angle	Cosine
0	1·000	16	·961	32	·848	48	·669	64	·438	80	.174
1	·999	17	·956	33	·838	49	·656	65	·422	81	.156
2	·999	18	·951	34	·829	50	·643	66	·407	82	.139
3	·998	19	·945	35	·819	51	·629	67	·391	83	.122
4	·997	20	·940	36	·809	52	·616	68	·374	84	.105
5	·996	21	·934	37	·798	53	·602	69	·358	85	.087
6	·995	22	.927	38	·788	54	·588	70	·342	86	.070
7	·992	23	.920	39	.777	55	·574	71	·326	87	.052
8	.990	24	.913	40	.766	56	·559	72	.309	88	.035
9	.988	25	.906	41	.754	57	·545	73	.292	89	.017
10	.985	26	.899	42	.743	58	.530	74	.276	90	.000
11	.982	27	.891	43	.731	59	.515	75	.259		
12	.978	28	.883	44	.719	60	.500	76	.242		
13	.974	29	.875	45	.707	61	.484	77	.225		
14	.970	30	.866	46	.695	62	.469	78	.208		
15	.966	31	.857	47	.682	63	.454	79	.191		

Reduction of Watts With Greater Angle.—To show a simple case or two of the influence of lag on the part of the current, take an instance of 100 volts and 10 amperes operating in the circuit. If there is no difference of phase, the two power components operate simultaneously and the total energy = 10 × 100 × (cos 0° = 1) = 1,000 watts. If inductance causes a lag of 10°, then the total watts = 10 × 100 × (cos 10° = .985) = 985. If the inductance causes a further increase in lag, until it reaches a value equal to 30°, the true watts are 10 × 100 × (cos 30° = .866) = 866 watts. The power factors in these cases are respectively the ratios between the true watts and apparent watts or 1,000 ÷ 1,000, 985 ÷ 1,000 and 866 ÷ 1,000. The figures are therefore 1.00, .985 and .866 in all. The power apparent with ammeter and voltmeter would be 1,000 watts, because of no attention being paid to the angle of lag.

Alternating Current Rotaries for Polyphase Circuits.—The transmission of electrical energy over great distances, has developed with the increasing perfection and adaptability of the rotary converter. A power station, situated at a distant point, may by its means distribute its power with relatively great economy over an area beyond vision from its site. Certain standard voltages and frequencies are employed and embrace figures as follows: Alternations 3,000, 3,600 and 7,200 per minute corresponding to voltages of 125, 250 or 550 volts as required. The standard Westinghouse two-phase rotaries, according to their bulletin, receive at their collector rings, about .7 of the pressure given out at the commutator as a direct current. With a three-phase rotary at the collector rings, the ratio is about .6 of that given out at the commutator end. A two-phase 220 volt rotary can be so connected that with respect to the transformers supplying the power, 110 volts can be readily obtained for electric lighting on the three-wire plan. Sparking is almost entirely absent from this class of machines and changes in speed are in strict proportion to the frequency of the current from the central station. The result of variations in frequency causes "hunting" or pulsatory movement due to more rapid changes in frequency than can be responded to by the rotary.

Starting a Rotary.—If a rotary is connected directly with the supply circuit it will take a very heavy current with a very low power factor. It can be started by getting it up to speed by using a direct current and then switching in the other circuit. Another way, is to use a small induction motor to raise the speed. Tabulating the results gives the following.:

First—Starting a rotary by connecting to the alternationg current circuit.

Second—Starting a rotary by connecting to the direct current circuit.

Third—Starting a rotary by driving with an induction motor.

Rotaries may be employed for delivering an alternating current instead of a direct. They receive direct and give out alternating for special purposes. Standard sizes are constructed for frequencies of 25, 30 and 60 cycles, equal to 3,000, 3,600 and 7,200 alternations per minute. The voltages preserved in practice, as shown in stations are 250 and 550 volts.

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HEATING BY ELECTRICITY.*

BY H. ALLEN.

In the arts and crafts there are an exceedingly large number of processes in which the application of a high temperature is an absolute necessity, and a still greater number of cases where high temperature would be a source of considerable utility in reducing the length of time of many operations, as well as greatly facilitating many such operations as soldering, brazing, welding, melting, etc., if a convenient method of heat development was available at a reasonable cost. So far the electric current has not yet been exploited greatly in this direction, owing to the electric arc not being a suitable and convenient method for so many special cases, while the resistance method, when coils, etc., are brought into use as a heating medium, is subject to many inherent defects.

The resistance material called "Kryptol," consisting of a patented mixture partly composed of graphite, carborundum, silicates, and clay in a granular form, can be so readily handled by any ordinary skilled operator that a few details of its applications for such purposes as boiling, melting, etc., may be of service to many readers. The most simple form of apparatus (Fig. 1) may be described as consisting of a bed of refractory material having an electrode of carbon or other material at each end, to which the electric conducting wires are connected. These electrodes are situated some distance apart, according to the size of the stone, and the only further accessory that is required is Kryptol of proper sized granules to suit the available voltage of the current. If a quantity of Kryptol is spread, say, by means of a spoon, in a layer between the two electrodes, more or less current will pass through it in proportion to the thickness and width of the layer. For simply heating liquids, melting of lead solder and any metal of low melting point, the containing vessel may be simply laid on the bed of Kryptol. There are no regulating apparatus required to adjust the temperature, as all regulation is effected by manipulating the loose granules on the bed of the stone.

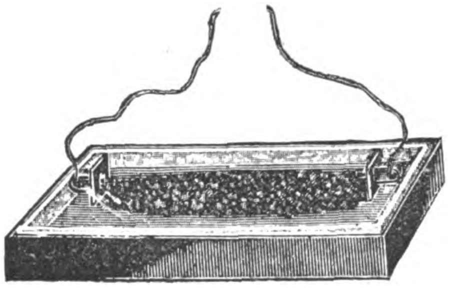

Fig. 1.

Supposing it was desired to weld two pieces of iron, in this case the pieces to be heated can be simply placed in the Kryptol, while by thinning down the layer, or making it narrower, the heat rapidly rises to any desired temperature up to about 3,600 degs. Fahrenheit. Another feature about this material is that it is made in different-sized granules to suit the voltage, the usual range being from 100 volts to 250 volts. In a simple test the writer melted a cube of copper weighing 8.45 grammes in one minute. The metal was contained in a small porcelain crucible resting upon the Kryptol, which had been brought up to the required temperature. The electric supply was at 240 volts, and 15 amperes were applied. This may not seem very economical in regard to cost of current, but a short time only is required to raise the temperature to a welding heat, and the current can be shut off immediately the required temperature has been attained. Several different forms of stones have been designed for use with this material, but the simple flat stone would be a great convenience for jewelers, dentists, chemical laboratories, etc.

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The first passenger train run in the extension of the Subway under the Harlem River left Brooklyn Bridge at 2 o'clock last Thursday afternoon. It carried a party of newspaper men, General Manager Hedley and other Interborough officials.

AUTOMATIC SYNCHRONIZIN OF GENERATORS AND ROTARIES.*

BY PAUL MAC GAHAN.

The tendency in central station development is to eliminate as much as possible the personal element in operation; to introduce labor-saving devices reducing the cost of operation, and automatic apparatus of every description to minimize the amount of attendance required, so as to prevent errors and accidents, and to insure continuous operation.

The synchronizing of generators or rotaries has been the stumbling block in most installations; for a good many years the incandescent lamp method was the only one successfully employed to indicate when the machines were ready to couple. If the lamps were connected across the main switch to similar phases the voltage across their terminals would be a minimum when the machines were in phase, and a maximum when in opposition, thus indicating by their dark period the proper instant for throwing the switch in, and by their flickering or pulsation the amount the incoming machine differed in frequency from the 'bus bars. When the lamps were cross-connected they would indicate the proper instant when at their maximum brilliancy. Much was left to the judgment of the operator, for the lamp did not indicate whether the incoming machine was too fast or too slow, the illumination was a function of the voltage as well as the phase, and moreover, the darkness of the lamps embraced a very large angle of phase difference. It was necessary to estimate half the time of the dark period, and this was difficult to do, as incandescent lamps have a period of their own, requiring an appreciable time to heat up and cool off. Many will remember the time, and the careful, patient manipulation required to synchronize by means of lamps.

The first improvement in methods of synchronizing was the introduction of the "synchroscope," an instrument that rotated a pointer in synchronism with the difference in speeds of the machines; this instrument has the widest general application to-day, for it gives perfect indications of the phase relation between the machines at any instant, and whether the machine coming in is too slow or too fast. It does not, however, make an allowance for the time required to close the coupling switch.

The electrically-operated switches generally used for high-tension work, and sometimes even for low-tension work, require a certain definite time to close after the closing current is established. This time varies for different kinds of switches, and the operator has to make an allowance for it in synchronizing and must close the tripping contact in advance of the actual instant of coincidence of phase, to connect the machines in a safe and satisfactory manner. Moreover, he has to take into consideration the speed at which the synchroscope pointer is approaching the zero point, and make a greater angular allowance on the dial, when the speed is greater. He has to judge what difference in speed gives a safe coupling, and, as a usual rule, will wait until he gets the pointer practically stationary before throwing the switch in. Given a variable speed, or sudden surges in the power in addition to the above variable elements, the operator has to contend with a combination of circumstances that prevent the synchronization being made quickly and which require a man of judgment to control properly.

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*From the "Electrical Engineer," London.

*Paper read before the National Electric Light Association at its 28th convention, held at Denver-Colorado-Springs, Col. June 6-11, 1905.

Thus it will be seen that if a device could be designed that would automatically respond to the above variables, and close the circuit at the proper instant in a safe and positive manner, the skilled operator could be dispensed with and the coupling could be done in much less time.

A successful automatic synchronizer should fulfill the following conditions:

1. It should be certain and safe in its operation.

2. It should take advantage of the first favorable opportunity for coupling.

3. It should couple the machines as soon as the difference in speeds is reduced to a safe amount.

4. It should close the contact in advance of the period of coincidence a sufficient amount for the switch to act, thus coupling the machines at the exact point of synchronism. The greater the difference in speed, the greater should be this advance in angle, in order to make the time allowed constant. As different kinds of switches require different lengths of time to close, the amount of advance should be adjustable.

5. It should prevent the coupling taking place if the speed of the incoming machine differs too much.

6. If anything in the mechanism fails, it should prevent the coupling.

7. It should not close the contact when the machines differ seriously in their voltage, even though in phase. Although a fairly wide difference in voltage is permissible in synchronizing, and will not cause as great a rush of current as a wide difference in phase or speed, it should be nevertheless guarded against. A difference in voltage of 25 per cent. may cause a serious interchange of current between the machines; a difference of phase of 15 degs. will generally cause more.

There have been many attempts in the past to devise a satisfactory automatic synchronizer, but none of them heretofore have been successful as the apparatus did not fulfill all of the conditions described.

One of the best known of the early attempts at automatic synchronizing was the Pearson synchronizer. This device consisted of two controlling magnets mounted in the same case, each magnet serving to close a contact. The two contacts were connected in series with the closing coil of an electrically-operated switch; the magnet coils being connected in parallel, and connected to the incoming machine and 'bus bars in the same manner as incandescent lamps are connected in synchronizing. One of the magnets was provided with a movable iron core, retarded in its motion by a dash-pot, thus requiring an appreciable length of time to make contact, and operated to select a wave, or "dark period" of the lamps of sufficient length to give the main switch time to act and still render coupling safe. The other magnet had a free or instantaneous action, adjusted to close its contact only when the voltage across the synchronizer coils corresponded to a coincidence of the phases. Thus, in action, the magnet with the time element would close its contact when the difference in speed was small enough and the other magnet would complete the switch-closing circuit when the machines were in exact synchronism.

It will be seen from the description that the device does not fulfill all of the conditions enumerated; it makes no allowance whatever for the length of time required by the switch to act; it is true that the quick-acting contact may be adjusted to operate at a voltage corresponding to a slight difference in phase so as to make contact ahead of time, but this would mean that it could make contact the same length of time too late. If the speed suddenly changes after the slow solenoid has closed its contact there is danger of the second contact closing. Besides, the angular advance of the contact would not vary with differences in speeds, thus coupling the machines at too early a period when they approximated in frequency, and too late when they differed considerably, for the switch requires a constant time to close. These defects alone were sufficient to cause accidents in operation, except under particularly favorable circumstances, and thus rendered the device commercially a failure. However, the inventor deserves great credit for taking the first step in automatic synchronization and pointing out the advantages that would accrue with a device that would infallibly do the work.

The latest development in automatic synchronizing is a new device perfected very recently, which seems to fulfill all the eight conditions enumerated in a highly satisfactory manner. It differs entirely in its operation from the Pearson synchronizer, which was described quite fully so as to accentuate the features necessary for a successful synchronizer as well as to throw a light on early progress. This new synchronizer consists of a pair of solenoids, each actuating a laminated iron core, supported from opposite ends of a rocker arm. Each solenoid is wound in eight separate sections, alternate sections being connected in series, thus forming two circuits in each solenoid; one circuit of each solenoid is connected in series with a circuit of the other solenoid, thus forming two independent circuits in the instrument, each circuit having half of its turns on each solenoid (see Fig. 1). One circuit is connected to a pair of binding posts deriving current from the 'bus bars and the other circuit to binding posts connected to the incoming machine. The connections of the various sections are so made that when the incoming machine is in phase with the 'bus bars, the currents in the right hand solenoid act in conjunction, thus pulling down the core, and the currents in the left-hand solenoid neutralize or cancel each other magnetically and produce no pull. On the other hand, when the machine is in opposition to the 'bus bars, the currents in the right-hand solenoid neutralize and the left-hand solenoid exerts a pull, its currents acting in conjunction.

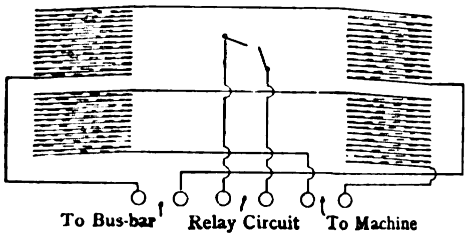

FIG. 1.
Schematic Diagram of Internal Connections.

The cores are suspended so as to reach the magnetic neutral of the coils at their extreme down stroke; thus, when the machines differ in speed, the horizontal beam rocks to and fro with a harmonic motion. As the incoming machine approaches the frequency of the 'bus bars, the motion becomes slower and finally ceases when the machines are at the same frequency. If the machines are in phase the right-hand core will stop at its lowest position, unless the voltages differ considerably when the currents will not neutralize, and the core will not be able to reach its extreme stroke. The left end of the rocker arm carries a contact spring marked a in Fig. 2, which slides along the top of a fiber segment b. This segment has a platinum strip c on the top, which in conjunction with the stationary spring d forms the contacts of the relay circuit. The springs and contact are of such length that when the segment is stationary contact can only be made when the right-hand core has reached its extreme position.

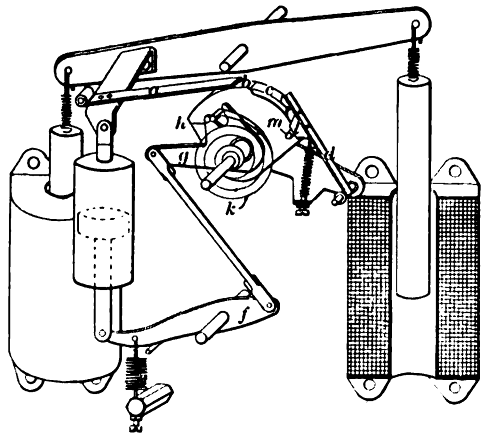

FIG. 2.
Contact Mechanism.

The vital characteristic of this instrument—the one that makes it successfully cover the requirements given for automatic synchronizing not heretofore met is the peculiar motion imparted to the contact segment. Instead of being stationary, it is pivoted on a shaft concentric with the rocker-arm shaft, which latter on its left half carries the chamber of a dash-pot, the motion of whose piston is opposed by a spiral spring in the manner shown in Fig. 2.

When the left end of the rocker arm rises, it tends to lift the piston of the dash-pot and elongate the spring e. Upon the return stroke a valve in the dash-pot opens, allowing a quick return motion.

The piston rod of the dash-pot carries an arm f, which is so attached to the contact segment as to shift the latter to the left, thus advancing the position of the contact when the rocker arm moves up with a sufficient speed to draw up the dash-pot piston. The slower the motion of the rocker arm, the less the piston of the dash-pot is raised, and consequently, the less the contact segment is advanced.

It will be noted from Fig. 2 that the arm f does not act directly on the segment, but operates a brass fork g between the prongs of which is a pin h, which is screwed into the contact segment. There is a spiral spring k between the contact segment and the fork which tends to keep the pin against the right prong of the fork. The pin has thus about one-eighth of an inch of play, the purpose of which will be apparent later.

Turning our attention to the right-hand, or stationary, contact spring, it is seen in Fig. 2 that this spring carries a cam l, the inclined edge of which is met by the pin m upon the return stroke of the contact segment. This stationary contact spring is of such strength that the pin m can not raise the inclined edge of the cam, for the contact segment is being actuated through the weaker spring k. Thus, upon its return stroke, the contact segment is delayed for an instant until the left prong of the fork g, touches the pin h and thus forces up the cam. As soon as the pin m reaches the end of the inclined plane the contact segment is free and is snapped over by the spring k. The purpose of this action will be apparent later. It will be noticed in Fig. 2 that the position of the stationary or right-hand contact spring can be varied. This, in conjunction with the adjustment of the spring e, is for the purpose of adjusting the difference in speed of the incoming machine at which the synchronizer will couple. Thus, when the difference in speed is too great to allow safe coupling, the dash-pot piston will advance the contact segment sufficiently to drop the stationary spring away from the contact plate and down upon the insulated portion of the contact segment, thus preventing the contact from being closed when the right-hand core comes down. The retarded motion of the contact segment prevents contact being made as the right hand core rises allowing time for the left contact spring a to get out of the way.

The foregoing descriptions of the actions of the various parts may seem very complicated, but it must be remembered that the instrument has a very complex function to perform. Indeed, an observer of its action in actual service said that it acted in a manner almost human. It is, in fact, more reliable, quicker, and couples the machines with less surge of current than can be done by the most skillful operator, Considering this fact, it seems surprising that the proper action can be obtained with such a small number of parts. To better understand the operation let us follow it in the act of synchronizing.

As the voltage of the incoming machine builds up and it approaches the approximate frequency of the 'bus bars, the rocker arm oscillates violently, the dash-pot piston advancing the contact segment so far that no contact is possible, no contact being possible on the return stroke. As the speed of the incoming machine increases, the rocking becomes slower and the dash-pot piston advances the contact segment less, until finally the right contact spring no longer drops away from the contact, and as the right-hand core descends the left-hand contact spring advances to meet the contact, thus energizing the auxiliary relay in Fig. 3, which operates the switch-closing circuit just sufficiently ahead of the point of coincidence of the phases, so that actual coupling takes place at the exact instant of synchronizm. If the machine approaches the point of synchronism more slowly there is less advance of the contact segment, and the actual time allowed for the switch to act is the same as before. In the extreme condition, when the machine is coming in very slowly, there is no appreciable advance of the contact segment, the dash-pot having time to exhaust. The amount of the advance of the segment can be adjusted to suit switches having different times of closing by varying the tension of the spring E. As pointed out before, the cores cannot attain their extreme position and therefore the contacts cannot be closed if the voltage is too far out for safe coupling.

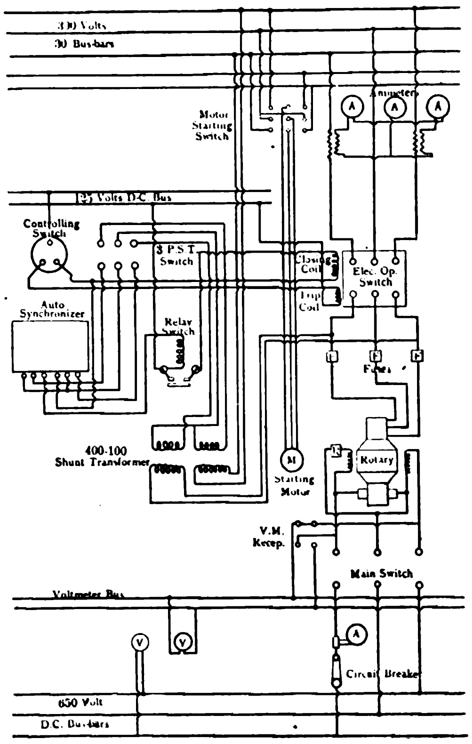

FIG. 3.
Diagram of Connections of a Rotary Converter Equipped with an Automatic Synchronizer.

The auxiliary relay takes very little energy, so there is not enough sparking on the platinum contacts of the synchronizer to burn them.

Fig. 3 is a complete wiring diagram of a rotary transformer equipped with the automatic synchronizer; by means of proper synchronizing plugs such as are used for either the lamp method or the indicating synchroscope one automatic synchronizer can take care of any number of machines.

A controlling switch, such as used with oil circuit-breakers, is interposed in circuit with the synchronizer and electrically-operated switch. By means of the controlling switch, the main or electrically-operated switch or oil circuit-breaker may be tripped but cannot be closed, as the closing coil is normally out of circuit until the synchronizer completes the contact.

An automatic synchronizer would be particularly desirable in the operation of large electric railway systems. When accidents occur which entirely shut down one or all substations, it is exceedingly important to be able to start up with the least possible delay, and there has been considerable discussion lately as to the best means of starting up the rotaries. If they are started directly from the alternating current side, a small number only can be started at once, otherwise there will be too much inductive load on the generating station. This method, therefore, requires considerable time. Starting from the direct-current side presupposes the presence of direct current power and necessitates a preliminary adjustment of the rheostats. However, if alternating current starting motors are used and an automatic synchronizer is installed for each rotary in order to start the substations it would only be necessary to throw in all the starting motors as quickly as possible and leave the rest to the automatic synchronizers, no furthur attention being necessary.

The first of these synchronizers has been in actual operation at the main station of the Pittsburg, McKeesport and Connellsville Street Railway for several months successfully and there are others in successful operation at the sub-stations of the New York Edison Company, the Manhattan Elevated Railway Company and the Brooklyn Rapid Transit Company.

They are thus no longer an experimental device, but an assured success, and a great advance in the handling of alternating current generators and rotaries.

It is reported from England that the Board of Trade has concluded a contract with Marconi's Wireless Telegraph Company providing for the installation of the Marconi system in lightships. The arrangement is expected to materially facilitate communication with the shore and between different lightships for the ordinary purposes of the lightship service, and also to report ships in distress.

CAN A STEAM TURBINE BE STARTED QUICKER THAN A RECIPROCATING ENGINE?[*]

BY A. S. MANN.

If a large steam turbine is cold and at rest, how quickly can it be started? Can it be brought up to speed as readily as can a good cross-compound engine that is cold all over?

Most station men would have doubts as to the adaptability of the large turbine, say 1,500 kw., or 2,250 hp., for emergency work. So much has been written about the sensitiveness of a rotating disk to the changes of temperature and the effects of unequal expansion, that it is easy to imagine difficulties in the rapid start. The possibilities of an engine with a 62 inch low-pressure cylinder in starting practically cold and coming up to synchronous speed are well understood. A station manager would criticise an engineer who would open his throttle as fast as he dared without wrecking his piping system and let his machine jump into her work. One turn at a time on the throttle is about all that is considered safe, and even then a close watch is kept for groaning valves and cold back bonnets.

Every time the starting valve is moved to increase the steam flow, the engine is allowed to take its full increment of speed due to that particular throttle position, before the supply valve is moved a second time. There are 10 large oil cups, and frequently more that must be opened and adjusted before the machine moves at all, beside whatever oiling is to be done about the air pumps and other auxiliary apparatus.

Most engineers would consider 10 minutes as rather a fast start and 15 minutes as a more usual starting period, including time taken for warming up; in fact, it may not be overstating the case to say that if it were known that an engine-driven plant were to be called upon in emergency for power, and it were essential that the briefest possible time were to elapse between the call and the taking of the load, one or more engines would be kept in motion all the time, turning slowly and hot all over.

This question makes itself very prominent when the steam station is operated as an auxiliary to a large source of high tension power, which is itself in the construction stage and has a large overload capacity of its own to carry, supplying all sorts of apparatus that use electric power; such as railway, lighting and power circuits simultaneously.

At such a time all sorts of accidents will happen to the high-tension water-driven plant, most of them due to the necessarily temporary character of many of the electrical connections. It takes months before an intricate system of wiring can be thoroughly relied upon, for it takes months before the temporary work of construction can be replaced.

The station at present under consideration is equipped with three Curtis turbine-driven alternators, 40-cyle, 10,000 volts, each of 1,500 kw. normal capacity. During the summer months the station is operated as an auxiliary to a water-power plant, taking all sudden overloads.

A signal has been arranged, a ¾-inch whistle, so that it can be blown instantly, should the power fail. A blast of that whistle means—cut in two turbines and bring the third up to speed. The load will be heavy, and all auxiliary apparatus must be in regular operation.

Each turbine has a surface condenser, and there are three or four pumps to be started for each pair of turbines, one circulating pump, one combined hot-well and feed pump, one pressure pump for the step bearings and one dry air pump, all of which are motor driven. The exciter is driven by a steam engine, and must be started also, for it supplies current to a portion of the auxiliary apparatus.

The boiler-room has steam up at all times, supplying a system for manufacturing purposes other than power, and slow fires are kept in enough boilers to make the steam needed for the normal load. Forced loads mean forced fires. The boilers have under-feed stokers, equipped with pressure blast, and will respond quickly to a 50 per cent. excess call for steam. The operating staff for this is about equivalent to a staff for an engine-driven plant. Engineers and oilers, however, are busy about the building on construction work, installing new apparatus and taking such work as their regular occupation when the turbines are not running.

At the sound of the whistle the water-tender starts a blower on the extra row of boilers; all blast dampers are opened up and all stokers are allowed to feed at the maximum rate. Each fireman dumps his free ash and bars over his red fire.

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[*] Paper read at the June meeting of the American Society of Mechanical Engineers.

The man in charge of the coal and ash conveyor starts the pressure pump for the step bearings, One of the turbine men starts the exciter which supplies current to the auxiliaries beside its field current; a second turbine man starts the circulating pump and then his turbine. The hot-well pump and the air pump are started by the oiler. These movements take place simultaneously. The force is organized upon the lines that obtain in a fire station; each man has his specific duty, and after performing it looks to see that there is nothing more for him to do. Only a few seconds elapse between starting the first pump and starting the first turbine.

The turbine throttle is opened as fast as an 8 inch steam valve can be opened without endangering the steam piping system. It is not considered advisable to open the throttle valve as fast as a man's strength will permit; but if nothing unusual occurs in the pipe line, sentiment does not spare the turbine.

One electrician attends to the switchboard and telephone. As soon as the machine approaches speed, the synchronizing system is cut in and the main switches are got ready. One and one-half minutes will do all the work here outlined, including the time taken in mustering the crew from various parts of the building, itself not a trivial matter.

Manipulating an engine regulator so that it shall be at a precise speed and at an exact phase relationship from some other machine not more than $\frac{1}{1500}$th part of a second removed from it, is no matter that can be hurried, and one minute is fast time on such work. But the whole thing, phasing-in and all, has been done in 2½ minutes, including full load on the turbine, which started from a standstill.

This performance has been gone through a great many times and our record book shows that out of 43 such calls, 10 starts were made in 2½ minutes, 18 in 3 minutes and 15 in 3½ minutes.

We have taken the time in a number of instances when all the auxiliaries have been in motion and is only remained to to start the turbine and phase it in on the line; the only valves to open in such cases are the throttle and one small oil valve. The two quickest starts have been made in 45 seconds and 70 seconds, respectively, including phasing in. Others range between 1 minute 10 seconds and 1½ minutes. These two quickest starts were made on a turbine which had stood for 24 hours with the throttle valve shut tight, though there was a slight leakage past the seat. After the throttle valve is off its seat it is not more than 30 seconds before the turbine is up to speed. A cross-compound reciprocating engine of the four-valve type, 2,250 hp. capacity, can be brought up to speed from a standstill in 5 minutes if it is hot all over. This 5 minutes is to be compared with the 70 seconds required for the similar turbine operation.

A reciprocating engine, which is turning over slowly with the throttle valve just off its seat, or with by-pass open and having all its oil cups open and regulated, can be brought up to speed, say 75 turns, in 2½ minutes. This can be compared with the 30 seconds necessary for bringing the turbine up under the same conditions, that is, about one-fifth the time necessary for bringing up the engine.

If the engine is cold all over and has all its oil cups shut tight, all its auxiliaries quiet, 15 minutes is called a rapid start. Starts have been made under such conditions in 12 minutes. When we start a cold turbine, we open up the valve and let her turn, and in 2 minutes we are ready to bring her up to speed, and she will be at speed in 2½ minutes, dividing the engine's time by more than four.

SIGN AND DECORATIVE LIGHTING.*

BY LA RUE VREDENBURGH.

Your reporter desires to consider the subject of Sign and Decorative Lighting from an entirely practical and matter-of-fact point of view, presenting what must be designated as more of a paper on the subject than a report embodying data obtained from member companies of the association.

The reports on this subject submitted at the conventions of 1903 and 1904 were so carefully and ably prepared, so handsomely and profusely illustrated, and altogether so artistic and exhaustive, that your present reporter despaired of being able to follow along similar lines without being hopelessly distanced by his pacemaker, and, consequently, with the entire absence of illustrations, will endeavor to deal with the subject from the standpoint of the lighting company, that soulless entity which looks at all things through commercial glasses and prizes all undertakings in exact proportion to their money-making capabilities. In other words, your reporter desires in this paper to avoid entirely the artistic and æsthetic, and to deal with the subject of sign and decorative lighting from its purely commercial side.

It is undoubtedly a safe assumption that the business world recognizes the increased drawing force of an illuminated sign over a plain one, not only on account of the additional hours of its usefulness, but also on account of the attractive efficacy of light. With this assumption granted, the central station desiring to increase the number of its sign customers has a good proportion of its work already accomplished, for there is no need of entering into an argument to establish the superiority of its commodity. The only thing necessary for the salesman to do is to convince the prospective customer that an electric sign on his place of business will add to its attractiveness sufficiently to justify the necessary outlay, and by "attractiveness" is meant power to attract and hold customers. This power to attract may consist of a variety of attributes. Some business houses attract solely by the quality of the goods offered; others by the beauty of their decorations or the artistic nature of their display; others by the convenience of their location; others by courteousness and consideration of the wants and wishes of their customers; others by their prompt delivery of goods and the reasonableness of their prices.

The chief power of such attributes is to hold customers after they have been secured. The enterprising merchant, however, is not satisfied with simply holding his own; he must be continually adding to his own or retrogression follows. Hence there is a constant and ever increasing demand for methods, the use of which will bring new trade, and here opens the limitless field of advertising with its numberless methods and inexhaustible means. It is desired here, however, to consider only the value of electric signs and decorations, and these not so much as advertising mediums as important features of a central-station demand.

There can be no question of the increasing demand for and appreciation of the electric sign. A comparison of the present appearance of the streets of any city in the country with their appearance a few years ago emphatically attests the public appreciation of electric light, not only in signs, but also in window decorations and in general illumination. One of the large lighting companies has more than trebled the number of its sign customers during the last year and a half, another has increased its sign business 33⅓ per cent. within a year, having added about 600 signs of all sizes. This company has adopted the policy of supplying and installing signs free of charge under contract, provided the customer will agree to keep the sign a certain length of time and burn it either fixed hours or a certain stipulated amount as governed by a minimum bill. In most of the signs so put out by the company referred to 4 cp. lamps are used, although in some cases 2 cp. lamps are used, and in a few, lamps of larger candle-power are installed. The consensus of opinion seems to be that 4 cp. lamps are the best for general sign illumination. In most of the larger cities the majority of signs burn until midnight, but some of the companies have a 10 o'clock switching hour, and most of the signs that burn upon meter do not average as late as 10 o'clock.

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*Paper read before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11, 1905.

One thing that has acted as a decided handicap to the introduction of electric signs in many cities and towns is the restriction placed by ordinance on the size and position of signs. In many cases they are prohibited from projecting more than 2 feet from the building line. In general, these ordinances were enacted before the value of electric signs to the municipality itself was fully realized. A little properly-directed effort on the part of the lighting companies will undoubtedly tend to the correction of this condition, as the benefit accruing to any town from the added illumination of its streets by means of signs is so self-evident that but little argument is necessary. A revision of the antiquated ordinances regarding signs has been accomplished in Chicago; there is still a restriction as to size, and a license of a certain amount per square foot is levied annually to provide for a rigid inspection of hanging, etc. A certain minimum number of lamps is also required, in order to prevent anyone's putting up an immense board sign with just enough lamps installed for it to be called an electric sign. The ordinance also requires that the lamps shall burn until half after 9 every evening, so as to insure the municipality's receiving the benefit of the illumination. There is no doubt that a large number of the cities and towns in this country could be induced to enact similar ordinances. It would certainly be the means of making the cities much more attractive, and would give the lighting companies a greatly augmented revenue.

The method pursued by one of the large companies last year was a persistent and systematic advertising campaign by means of letters, folders, mailing cards, booklets, return postal cards and inclosed stamped envelopes, sent to a selected mailing list secured by a thorough house-to-house canvass, including all retail merchants in all lines of business whose stores were sufficiently pretentious to possess a plate-glass window. This campaign last year resulted in more than doubling the number of sign customers. The company referred to supplies 4 cp. lamps for signs only. The above result was obtained in a city where an ordinance restricts the projection of signs to 2 feet from the sidewalk line, consequently most of the signs installed are either vertical or flat against the face of the building. Most of the large companies use electric signs for their own advertising, thus proving their faith in what they recommend to others; the effect of this is undoubtedly in the right direction.

The rather large initial cost of electric signs has always militated against their use, but recently manufacturers have been directing their energies to the reduction of this first cost, with the result that some very effective signs are now on the market which may be purchased at a very reasonable cost. One of the recent improvements is the thermostat control, by means of which a sign is flashed without the use of a flashing switch. This is only practicable, of course, on comparatively small signs, mostly for interior use.

In some cases, as mentioned before, the lighting companies furnish and install signs free of charge, these, of course, of some standard make and type; in others the customers are required to pay for same in small monthly installments. This can undoubtedly be done at a profit to the company, as signs are usually burned for long hours; and while part of this is on the peak of the load a good proportion of it is at a desirable time, and companies should bear in mind that every sign installed is a distinct and emphatic advertisement of their business. Many commodities purchased by the public are taken away and used at home, or in other places where no one but the possessor sees them, but the electric sign is meant for purposes of display and advertisement, and not only advertises the owners, but also the makers of the sign and the company that furnishes the electricity.

One of the larger companies (and possibly others) has placed the sign business in the hands of one man, who is especially qualified by experience and study to handle this branch of the business. The great majority of merchants when considering the subject, are completely at a loss as to what size and style of sign to adopt, and invariably consult the lighting company for advice in the matter. An expert should be able to advise the prospective sign customer in all matters of detail, and as the conditions are so varied and the possibilities so unlimited, judicious advice from such a source is of great value to both customer and company. No effort should be spared to insure the customer's installing the most efficient and most economical sign. It can readily be seen that there is an opportunity for the exercise of a great deal of ingenuity and good judgment in planning or selecting a suitable sign. The candle-power of the lamps installed should depend upon the location of the sign, whether same is intended for long-distance exposure, for interior use, or in narrow streets low-down on buildings, where from the nature of the surroundings the sign may be seen but a comparatively short distance.

So many matters of detail must be considered that the adoption of any standard type and style of signs is practically impossible. The lighting companies are naturally inclined to encourage the use of exposed lamp signs, as they consume the greatest amount of current; but there are a number of other types of signs that are much less expensive to construct and also to operate, such as illuminated boards, transparencies, etc. The value of a satisfied customer as a medium of advertising is universally recognized, and it is much better to equip a small customer with an inexpensive sign, which he can operate at a moderate cost and continue to operate for an extended period, than to persuade him to install an expensive one, the maintenance of which is more costly than the size and nature of his business would justify, for such an experience would naturally tend to prejudice him against the use of signs in general.

The subject of window lighting might justly be considered under this heading, as the conspicuous illumination of a show window has a distinct value apart from simply displaying the goods therein contained, for the well-lighted window attracts almost as much attention as a brilliant sign, and is the primary inducement tending to further investigation by stimulating curiosity. One notable case exists where a large store window is most strikingly illuminated with no goods displayed, nothing but cards and placards intimating what beautiful and attractive goods may be seen within. This might not prove altogether satisfactory as a permanent arrangement, but as a temporary change should prove effective, and might induce persons to enter in order to satisfy a curiosity, which, were the goods in the window, would be satisfied without entering the store. Of course the main thing is to persuade people to come in—after that the salesman must do the rest. The Boston Edison Company has installed in its exhibition rooms a sample show window with five different schemes of lighting, illustrating the effect of concealed lamps, reflector lamps, overhead lighting, side lighting, Meridian lamps and various combinations of the above-named methods; this has undoubtedly been of service to customers in determining upon what method to adopt and to the company's salesmen in advising customers along this line.

As to decorative lighting, while all light is inherently decorative, there is no artificial illuminant that lends itself so readily to ornamental and decorative effects as does electricity. In fact this is limited only by human ingenuity, and the improvements during the last few years along the line of handsome and artistic electric fixtures have been most marked. The possibilities along the line of extensive out-door decorative effects by means of electric lights have been most satisfactorily demonstrated at the various expositions held in this country during recent years. Probably the most effective and interesting display of this sort was made at the Pan-American Exposition at Buffalo. Conditions were particularly favorable there, and were taken advantage of to the fullest extent. Local out-door decorations in various cities do not appeal very strongly to the lighting companies, on account of their excessive demand for but a brief period, occurring usually at the time of the heavy normal load. They are, however, of value to the companies in opening the eyes of the public to the possibilities along this line. There is probably no system that lends itself so readily to this kind of work as what is known as the "Eblight," system, but its rather excessive first cost militates against its general use. This system is adapted well to interior decorations, and as this kind of work is something for which there is more or less of a constant demand the lighting companies may well afford to give the subject careful attention. The "Miniature Decorative Lamp Sets" gotten up by the General Electric Company are admirably adapted to a great variety of interior decoration, especially to Christmas trees.

Another field that shows quite a promising crop for lighting companies is the illumination of bill-boards. These are generally controlled by advertising concerns, who are beginning to appreciate the increased value of their space when properly illuminated. This is also appreciated by the advertisers, for they realize that the illumination of a sign-board adds about five hours each day to its usefulness, and they are willing to pay for these five hours. Some of the lighting companies whose lines extend through country districts in reaching suburban towns are beginning to light the large bill-boards displayed along railroads and highways. This should be profitable lighting wherever the boards are within a resonable distance of the company's lines.

Another type of sign which appeals strongly to the general advertiser is the so-called "talking sign." This sign, although quite expensive to install and only adapted to use in large cities, is of such versatility and attractiveness, enabling the user to present such varied and extended arguments, that it should prove a profitable investment. The lighting companies cannot afford to overlook or neglect that branch of the business covered by sign and decorative lighting, for it has already assumed decided prominence, and its future is almost unlimited. This is an advertising age, and the newer and more progressive methods are eagerly sought and adopted.

WRINKLES.*

EDITED BY H. C. ABELL.

Splitting Secondary Network Into Sections.

About a year and a half ago we had considerable trouble with our secondaries, which are all connected in a multiple network. If a primary fuse blew out it greatly overloaded the other transformers and burned out a number. We very successfully overcame this by making use of a lot of old break arms; we deadened the secondary to each side of the break arm and completed the circuit by placing a No. 12 or No. 14 copper wire across the arm. G. F. WILLARD, Denver, Col.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 4, 1905.

Electric Railways and Appliances.

793,671. Electric Automatic Block System for Railways. George H. Lower, Robert H. Lower, Edward P. Lower, Winfrey W. Lee, William B. Lee and Herbert Walker, Hot Springs, Ark. Filed July 23, 1904.

793,754. Insulation. George A. Weber, New York City, assignor to the Weber Railway Joint Manufacturing Company same place. Filed Feb. 10, 1903.

793,827. Automatic Signal and Train-Control System. Henry M. Davenport, Longbeach, Cal., assignor to the American Switch & Signal Company, Los Angeles, Cal. Filed Sep. 8, 1904.

793,965. Trolley. William F. Thompson, Coraopolis, Pa. Filed Dec. 28, 1904.

794,020. Trolley-Head. Harry I. Jeffers, Tuscaloosa, Ala. Filed Aug. 20, 1903.

Electric Lights and Appliances.

793,774. Multiple Electric-Lamp Holder. Elias L. Elliott, New York City, assignor to the Illuminating Engineering Company, same place. Filed June 5, 1903. Renewed May 23, 1905.

793,952. Electrical-Lamp Fixture. Benjamin W. Perrigo, Auburn, N. Y. Filed Nov. 3, 1904.

794,028. Bulb for Incandescent Electric Lamps. Robert R. Kintz, Meriden, Conn., assignor to the International Silver Company, same place. Filed May 15, 1905.

Electrical Machinery and Apparatus.

793 722. Current Motor. Peter Henrichs, Clarkston, Wash. Filed March 27, 1905.

793,768. Motor Control. Eugene R. Carichoff, East Orange, N. J., assignor to the Otis Elevator Company, same place. Filed Dec. 8, 1903.

794,848. Electric Controller. Charles S. Reno, Covington, Ky. Filed March 11, 1905.

793,897. Electric Switch System for Blast Furnaces. Robert G. Mc Farland, Newcastle, Pa. Filed Nov. 10, 1904.

793,904. Induction Motor. William D. Pomeroy, Norwood, Ohio., assignor by mesne assignments to the Bullock Electric Company. Filed Nov. 24, 1903.

793,929. Controlling Mechanism for Variable Speed Transmission. Norman T. Harrington, Detroit, Mich., assignor to the Olds Motor Works, same place. Filed Nov. 21, 1904.

794,135. Induction-Motor. Edwin C. Wright, Newport, Ky., assignor, by mesne assignments, to the Bullock Electric Company. Filed Nov. 24, 1903.

Telephones and Telephone Apparatus

793,826. Telephone Attachment. Nero E. Damico, Redlands, Cal. Filed Jan. 31, 1905.

793,845. Automatic Take-Up Device for Telephone Connections. Frank B. Long, Los Angeles, Cal. Filed Oct. 15, 1904.

793,928. Telephone-Transmitter. William E. Harkness, Elyria, Ohio, assignor to the Dean Electric Company, same place. Filed March 18, 1904.

793,941. Telephone-Exchange System. Edmund Land, Grand Rapids, Mich., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Filed Jan. 23, 1903.

793,971-972. Telephone-Exchange System. Harry G. Webster, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufactgring Company, Rochester, N. Y. Filed April 17 and March 25, 1903.

794,016. Telephone Attachment. Frank F. Howe, Marietta, Ohio. Filed March 2, 1905.

794,112. Service-Meter for Party Telephone-Lines. James L. Mc Quarrie, Chicago Ill., assignor to the Western Electric Company, same place. Filed Jan. 29, 1903.

794,116. Telephone Attachment. Valetin Rebhun, Schaghticoke, N. Y., assignor of one-half to John Liddle, Hoosick Falls, N. Y. Filed Oct. 17, 1904.

Miscellaneous.

793,648-649-650-652. Receiver for and Signaling by Electromagnetic Waves. Reginald A. Fessenden, Washington, D. C. Filed Dec. 14, 1904; March 30, 1905, and April 6, 1905.

793,651. Aerial for Wireless Signaling. Reginald A. Fessenden, Washington, D. C. Filed March 30, 1905.

793,718. Wireless Telegraphy. Reginald A. Fessenden, Washington, D. C. Filed March 30, 1905.

793,760. Art of Telegraphy. Marcus O. Anthony, Barberton, O. Filed Nov. 22, 1902.

793,775. Fire and Burglar Alarm. Peter M. Esser, Chicago, Ill., assignor of one-half to Julius G. Breitenstein, same place. Filed Aug. 29, 1904.

793,802. Electric Protective Apparatus. Frederick R. Parker, Chicago, Ill., assignor to Frank B. Cook, same place. Filed July 9, 1904.

793,833. Insulating Handle Connection. John H. Gault, Philadelphia, Pa. Filed June 8, 1904.

793,881. Secondary Battery Isidor Kitsee, Philadelphia, Pa. Filed March 17, 1893.

793,896. Submarine Signal. Arthur J. Mundy, Boston, Mass., assignor to the Submarine Signal Company, Waterville, Me. Filed Feb. 14, 1903.

793,936. Electric Push-Button. Henry F. Keil, Bronxville, N. Y. Filed Feb. 27, 1905.

793,942. Supporting Device for Electric Fans. Sidney G. Leach, Ilford, England. Filed Sept. 14, 1904.

794,012. Electric Temperature-Alarm. Cowan P. Hepler, Smithton, Pa. Filed Feb 6, 1905.

794,117. Electric Spark System. Frank I. Remy and Benjamin P. Remy, Anderson, Ind., assignors to the Remy Electric Company, same place. Filed Nov. 4, 1904.

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*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

THE TELEPHONE WORLD.

More Telephone Facilities in New York.

Plans were made last week by the New York Telephone Company to put in a new switchboard in the 38th street exchange, with a capacity for 5,000 lines.

A contract has been let by the company for the erection of a building for the Tremont branch at 178th street and Webster aven ue. This branch is to be equipped with a 5,000-line board.

A new board, which will increase the wires from from 6,000 to 10,000, is to be installed in the Columbus branch on West 58th street.

At the East 79th street exchange an addition of one story to the building is being made and also an addition of 17 feet to the frontage. This will increase the facilities from 5,000 to 10,000 wires.

Plans are being devised for the increase of facilities in the Cortlandt branch. An additional equipment of about 10,000 extra lines is to be installed.

Telephone Franchise for Philippines.

The Philippine Commission has passed an act granting to John I. Sabin and Louis Glass, of San Francisco, Cal., a franchise to construct telephone and telegraph systems throughout the Philippine Islands. Mr. Sabin is president and Mr. Glass vice-president of the Pacific States Telephone & Telegraph Company.

Automatic Telephones for Cuba.

Announcement has been made by the Automatic Electric Company of Chicago of the closing of a contract for 15,000 automatic telephones of the type now in use in Chicago, for the Havana Telephone & Telegraph Company of Havana, Cuba. Of these, 5,000 are to be delivered immediately. The automatic instruments are to be installed in Havana and later on throughout the island of Cuba.

The Patrons' Telephone Company was lately incorporated with a capital of $2,500, to operate from Fulton to Cato, N. Y., connecting Bowens Corners and South Hannibal, Oswego County; Ira, Cayuga County, and Lysander and Baldwinsville, Onondaga County. The directors are George D. Adams, J. D. Beardsley and A. Berne Kellogg, of Fulton; Oscar H. Livingston, of Ira; David H. Marvin, of South Granby; Willard N. Cole, George N. Butler, and Charles J. Brown, of Lysander; D. D. Arnold, of Bowens Corners; Frank B. Watson, of Floridaville and F. N. Palmer, of South Hannibal.

Mr. Alonzo Burt, president of the Wisconsin Telephone Company, is preparing a series of lectures on the telephone, which he is arranging to deliver in different cities in the State where his concern has exchanges. Mr. Burt's object is to popularize the telephone and incidentally tell the public how to get the most benefit from the service and how to avoid things which cause interruptions.

The Pennsylvania Telephone Company has placed 'phones and strung wires preparatory to opening the line at Portland in that State,

Telephone Service to Save Bathers From Drowning.

News from Salt Lake City, Utah, announces that there has been installed one of the most peculiar telephone systems in the world. Three thousand feet from the shore of the great Salt Lake has been erected a telephone instrument that is in direct communication with an exchange on shore.

The fact that several persons have lost their lives while bathing in Salt Lake before help could be summoned was the primary reason for putting in the instrument. It has proved, however, to be very popular with tourists who are able to telephone over a radius of 500 miles to friends in other States.

The installing of the instrument was a very nice piece of electrical engineering. Every joint had to be perfect and the insulation of the best and strongest to resist the action of the powerful brine of the great inland sea. It was two weeks before the telephone could be brought to a condition to work without a hitch. Now it is possible to talk to Spokane, Wash.; Denver, Col., and the cities of Wyoming, Idaho and Utah from the waters of Salt Lake.

Better Service Promised by Independent Company.

The Independent Telephone Company of Syracuse, N. Y., was lately incorporated at Albany, for the purpose of taking over the property of the Syracuse Telephone Company, the stock of which has been purchased by a syndicate composed of John J. Cummins, president of the Syracuse Lighting Company; former Mayor Jacob Amos, Gates Thalheimer, Albert K Hiscock, former Corporation Counsel Alexander H Cowie, Hendrick S. Holden and Charles M. Warner, of Syracuse; Eugene Satterlee, of Pittsford, and Thomas W. Finucaine, George R. Fuller, Frederick W. Zoller and Carl Lamb of Rochester. Each director holds 50 shares of stock.

The company which organized the Syracuse Telephone Company was composed of Dr. John L. Wentz, Joseph J. Jermyn, Ernest I. White and others.

Mr. Cowie said that the new company would improve the service by putting in a new switchboard, extending the subway system and making a new exchange. The service would be the best that could be procured, he declared, at rates 30 to 40 per cent. less than those of the Bell Company.

The Rochester men are interested in an Independent Telephone Company at Rochester which is working in harmony with Independent companies in other principal cities of the State. The fact that the Rochester men would enter the Syracuse field was made public a few days ago, but it was supposed that the members of the old company would retain their interests.

The members of the new corporation are interested in various business and financial enterprises, and have plenty of capital to carry out their plans.

The Consolidated Telephone & Telegraph Company is stringing wires and getting ready to install telephones in Coopersburg, Pa.

Another Independent Telephone Association Formed.

The Independent telephone companies throughout the section around Kewanee, Ill., have organized an Independent telephone association, taking in the following counties: Henry, Bureau, Stark, Knox, Mercer, Warren, Rock Island, Peoria, Marshall and Henderson. A meeting was recently held at which a preliminary organization was effected. F.M. Ashe of Kewanee, was made temporary chairman of the organization, and W. S. McQuiston, of Monmouth, was made temporary secretary. A committe consisting of Messrs. Daily, of Chillicothe; Chase, of Galesburg, and McQuiston, of Monmouth, was appointed to arrange a schedule of tolls.

An important consolidation of Independent lines was effected at a recent meeting held in Appleton, Wis., between representatives of Fox River Valley Telephone Company of Appleton and the Valley Telephone & Telegraph Company of Green Bay and Depere. Representatives present at the meeting state that toll lines connecting all cities of the Fox River Valley and 45 other points in the eastern and northern parts of the State with local exchanges at all points will be in operation under one management by August 1.

The Perry County, O., Telephone Company with headquarters in New Lexington, has organized for the purpose of taking over the properties of the Sunday Creek Valley Telephone Company and the Central Union operating in Perry County. The new company which is made up solely of local capitalists, will operate in every town in the county, and outside of using the long distance lines of the Bell Company, will be strictly Independent. The officers of the new company are: President, E. S. Martin; vice-president, William A. Allen; secretary, T. M. Potter, and treasurer, C. B. Enlow.

Six Telephone Companies Merge.

At the quarterly meeting of the directors of the Diamond State Telephone Company held in Dover, Del., a short time ago, the final merger and consolidation of three telephone companies in Maryland, two in Virginia and one in Delaware, was confirmed and made absolute.

The number of directors was increased from seven to ten, and large appropriations were voted for the further extension of the line to Cape Charles.

No change was made in the officers of the company.

The Nebraska Telephone Company is making arrangements to improve the McCook telephone exchange. About $15,000 will be expended in the improvements.

Telephone Incorporations.

The Fort Cobb Telephone Company, Oklahoma, Okla. Capital stock, $2,500. Incorporators: R. A. Woolridge and John H. Wright, of Oklahoma, and E. J. Luce, of Fort Cobb.

The Lamar & Barton County Telephone Company, Lamar, Mo. Capital stock, $40,000. Incorporators: J. W. Layne, J. B. McGilvray, E. J. Layne, A. E. McGilvray and M. D. Perry.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Ackley, Ia —The Ackley electric light and heating plant has been sold by Smith Brothers to John Rath.

Bonham, Tex.—The Bonham Electric Light & Power Company's plant was lately sold to a Dallas firm, of which J. F. Strickland is president.

Clarksville, Tenn.—A movement has been launched here to organize a new electric light and power company. The company will be known as the Consumers' Electric Light, Power, Heating & Refrigerating Company.

Cottonwood Falls, Kan.—The Smith Light & Power Company, of Bolivar, Mo., has received a franchise from this town and will install an electric light plant here.

Fort Dodge, Ia.—A committee of five has been appointed to investigate the advisability of constructing a gas and electric light plant here to be owned by the municipality.

Los Angeles, Cal.—The city council has been requested by the Municipal League to secure advice and to make careful inquiry into the feasibility of the installation of an electric plant at public expense. to supply light for the streets and public buildings.

Missoula, Mont.—Plans have been prepared by Architect A. J. Gibson for the construction of the new plant for the electric light company.

Muncie, Ind.—After owning its electric lighting plant for 15 years or more, this city may purchase its electricity for street lighting in the future from a private company. A company has agreed to furnish power and light to the city for street lighting and other purposes at the rate of 3½ cents for 1,000 kilowatts, and it costs about double that to manufacture electricity at the city power plant. Accordingly, a franchise probably will be given to Jerome Herff, of Peru, who will obtain the power for his lighting plant by constructing a dam across Buck Creek, six miles from here, and utilizing a waterfall thus created.

Newark, O.—The Citizens' Electric Light & Power Plant was lately purchased by a syndicate headed by Congressman B. G. Dawes, of Marietta, and M. G. Gillette, of this city. The deal was said to have involved an amount in the neighborhood of $175,000. A company will be incorporated under the name of the Licking County Light & Power Company to take over the property.

Norfolk, Neb.—After months of investigation throughout the country, the city council at Wisner has decided to install an electric lighting plant here.

Penn Yan, N. Y.—The taxpayers of this village have decided by a vote of 57 to appropriate $3,500 to complete the municipal electric light plant.

Sioux Falls, S. D.—The Sioux Falls Electric Light & Power Company with a capital of $100,000 has been incorporated.

South McAlester, I. T.—The Choctaw electric light plant here was totally wrecked a short time ago, causing a loss of $10,000.

Stoughton, Mass.—A committee has been appointed to investigate the matter of changing the present arc system of street lighting to an incandescent system.

Tecumseh, Neb. —It has been decided to call a special election in the near future for the pupose of voting on the issuance of bonds in the sum of $9,500, for the purpose of installing an electric light plant.

Toledo, O.—Electric lights will be installed at Point Place. Chief Engineer Consul, of the board of public service, and City Electrician Tyler Green will complete plans and estimates of the cost of construction and operation of a municipal lighting plant for this city.

STREET RAILWAYS.

Chambersburg, Pa.—The Chambersburg & Gettysburg Electric Railway Company is to extend its lines to Greencastle, New Franklin, Brown's Mill and Middleburg.

Coalgate, I. T.—C. S. Young, representing Eastern capital, was recently here for the purpose of asking this city for a franchise for the construction of an electric railway to run from here to Atoka via Lehigh, Phillips and Midway.

Fairfield, Ia.—A very enthusiastic meeting was lately held at the Jefferson Club to discuss the proposed interurban railroad from Keosauqua to this city. E. R. Smith, R. B. Louden and others compose the committee.

Ithaca, N. Y.—The Auburn & Ithaca Traction Company has been formed here to operate an electric street railway 40 miles from Auburn to this city. Its capital stock is $400,000, and directors, Sherman Collins, Ithaca; E. B. Mosher and I. P. Hazard, Poplar Ridge.

Lake Providence, La.—The board of aldermen lately granted to the Lake Providence & Gouldsboro Railway & Power Company a franchise for 25 years for the purpose of building, equipping and operating an electric railway from here to the Gouldsboro suburb, and to Lake Providence Landing. The line is to be three miles long, and to be extended later on. The officers of the company are: Joseph L. Fischer, president; W. E. Dunn, vice-president; Edward J. Hamley, secretary and treasurer; Victor M. Purdy, W. T. Tyler, and Joseph E. Ramsdell, directors.

Noblesville, Ind.—W. B Campbell is promoting an interurban electric line between Anderson, Noblesville, Lebanon and Crawfordsville, and a corps of engineers has completed the survey between Anderson and this city. The promoter expresses confidence in his ability to finance the project.

Pueblo, Pa.—H. D. Livers will take charge of the construction work of the trolley line to be built between Mahanoy City and Tamaqua.

Racine, Wis.—An electric railway is to be installed between this city and Corliss.

Redding, Cal.—A company is forming here to construct an electric road through this city to Anderson, and across Clear Creek to Millville. The road is to cost $750,000.

Richmond, Ind.—Recent developments make it evident that the Widener-Elkins Syndicate of Philadelphia has in view securing control of the traction interests of both Ohio and Indiana. Already long steps in this direction have been taken, much of the property in both States having passed into the control of the syndicate. It is announced on good authority that the Columbus, Delaware and Marion line, operating out of Columbus, O., and owned largely by Indiana capital, is to pass into the hands of the Philadelphia people. The road is 50 miles long and one of the finest traction properties in Ohio.

Sheboygan, Wis.—The construction of an interurban trolley line from this city to Kaukauna via Manitowoc and Brillion is now a certainty.

South Bend, Ind.—George Townsend, builder of the Northwestern Traction Line, has secured the contract for the construction of an electric line from this city to Laporte.

St. Augustine, Fla.—The Jacksonville, Seashore & Seaside Railway Company has applied for a franchise to construct and operate an electric light and power plant.

Stoughton, Wis.—An electric railway between Madison and this city, with a possible extension later to other points, is an enterprise launched within the last three weeks.

Ticonderoga, N.Y.—The Ticonderoga Union Terminal Railroad Company has been incorporated to operate an electric and street surface road, five miles long. Its capital stock is $50,000, and incorporators, I. Rothschilds, Alexander H. Weed and A. B. Adkins.

Whitestone, N. Y.—A meeting of the leading business and professional men of this place was lately held here, and an organization was effected, the object of which is to induce capitalists to build a trolley line to this village. The organization was named the Whitestone Association. Frank E. Knab was elected president and Frank J. O'Rorke secretary.

Youngstown, O.—The Youngstown & Southern Railroad Company will enter this city soon and operate electric lines to the heart of the downtown district.

POWER PLANTS.

Ann Arbor, Mich.—Steps have been taken which look as if the water power along the Huron River will be greatly developed, involving the creation of an immense reservoir lake near Geddes, three miles east of here. R. W. Hemphill, Jr., has announced that a company of New York City is backing the project and has a capital of $30,000,000.

Blanche, Ala.—The preliminary surveys for the construction of the 18,000 hp. electric plant to be run by the utilization of the water power of the Little River on Lookout Mountain near here are now being made. The big plant will be constructed at a cost of about $1,000,000 by H. T. Henderson, and his brother, Sam Henderson, wealthy capitalists of Durango, Col., and their associates.

Chicago, Ill.—The Commonwealth Electric Company is about to begin the construction of another section of its great power plant at Fisk and 22d streets, to cost $450,000.

Helena, Mont.—The Missouri River Power Company is to build a second dam across the Missouri River for developing electric power at a cost of $1,000,000. The power will be transmitted to this city, Butte and intermediate points, the mines to be large beneficiaries.

Puebla, Mex.—Electric energy on a large scale is to be developed from water powers in the State of Puebla.

San Francisco, Cal.—Articles of incorporation of the Sierra Nevada Water & Power Company were filed recently. The company is capitalized at $5,000,000. The directors are G. B. Crittenden, W. L. Stowell, R. M. Kriesser, J. O. Bradford and C. H. Allen.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15@15⅛c.; Lake 15@15¼c.; casting, 14¾@14⅞c.

The Toledo Storage Battery Company of Toledo, O., was recently incorporated.

The Michigan State Telephone Company has declared the regular quarterly dividend of 1¼ per cent., payable to stockholders of record July 12.

The production and importation of refined copper during the first six months of 1905 is estimated at 461,000,000 pounds.

The earnings of the Boston & Worcester Street Railway Company for June were $45,415, an increase of 4 per cent. over the corresponding month last year.

A dividend of 1¼ per cent. will be paid in the stock of the Third Avenue Railroad Company of New York on August 1. Books close July 13 and reopen August 2.

In official quarters no information is obtainable concerning the reported plan which is said to be under consideration for reorganizing the Electric Vehicle Company.

The final step in the reorganization of the New Orleans Railways Company was the sale of the properties at foreclosure Saturday to the New York Security & Trust Company for $3,500,000.

Officials of the Interborough Rapid Transit Company of New York state that travel on the elevated lines, for the six months ended June 30, was fully equal to that of the corresponding period of last year.

The Electric Company of America (Philadelphia) has declared a regular semi-annual dividend of 3½ per cent, payable July 31, to stockholders of record July 20. Books close July 20 and reopen August 1.

The stockholders of the Easton (Pa.) Telephone and Telegraph Company have ratified the action of the directors in issuing $1,000,000 of consolidated mortgage bonds. The money is to be used in extending the lines of the company in the southern part of New Jersey.

John E. Blount, Jr., head of the bond department of the Merchants' Loan & Trust Company of Chicago, reports that the $250,000 of Commonwealth Electric 5 per cent. bonds purchased by the bank a short time ago were substantially all sold in 10 days.

The St. Louis & Northeastern Railway Company, which is to build a 70-mile extension of the Illinois Traction Company from East St. Louis, has made a mortgage to secure $3,000,000 five per cent. bonds. The bonds will be guaranteed by the Illinois Traction Company, and will not be issued until the property is completed.

Judge Julian W. Mack has decided in the Circuit Court at Chicago that the leases by which the Chicago Union Traction Company is in control of the street car lines of underlying corporations are valid. He has denied a motion for an injunction to prevent the company from continuing in control.

It is reported that negotiations have been completed for the transfer of control of the Connecticut Railway & Lighting Company properties to the New York, New Haven & Hartford Railroad Company. The Connecticut Company is controlled by the United Gas Improvement Company of Philadelphia.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price July 8.
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	200¼
Manhattan Elevated Railway	165½
Metropolitan Street Railway	127¾
Metropolitan Securities	83¼
Ninth Avenue	197
Third Avenue	131
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	71¾
Brooklyn City Railway	239
New Orleans Railway	..
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	83¼
Philadelphia Traction	100
Union Traction	59¾
Boston.	
Boston Elevated	157
Massachusetts Electric Companies, com	18¼
do. do. do. pref.	63
West End Street, com	98
do. do. do. pref.	114¼
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	6
do. do. pref.	38
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	15⅝
do. pref.	51⅝
Electric Boat, com	34
do. do. pref.	75
Electric Lead Reduction	¼
Electric Vehicle, com	17
do. do. pref.	21
Westinghouse, com	167¼
do. pref.	190
General Electric	176¼
Boston.	
Edison Electric Illuminating	245
General Electric	176
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	160
National Carbon, com	67
do. do. pref.	118
Philadelphia.	
Electric Company of America	11¾
Electric Storage Battery, com	76
do. do. do. pref.	76
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	140
Western Telephone Company	17¾
New England Telephone Company	188¼
New York.	
American Telegraph & Cable Company	90¼
Commercial Cable Company	210¼
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	179¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93¾
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Otis Elevator Company	60
Consolidated Car Heating	64
Standard Underground Cable	

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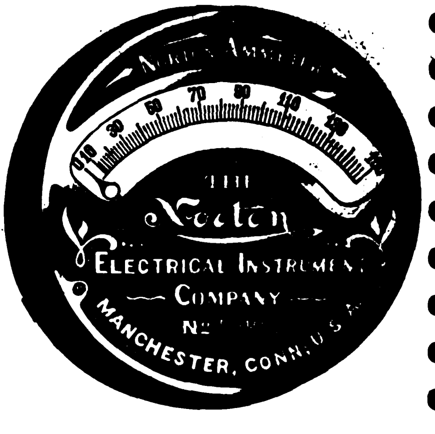
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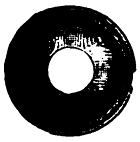

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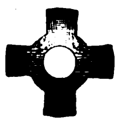

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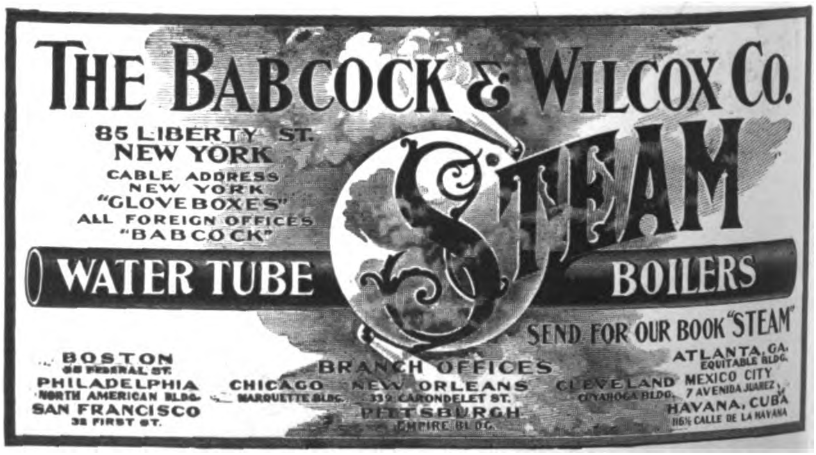

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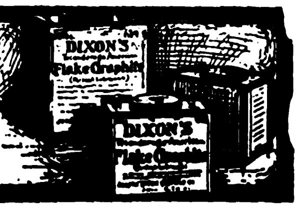

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ELECTRICITY.

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EDITORIAL NOTES.

A Responsibility for Engineers.

The technical school and college have become fixed institutions in the United States. Although an unusual industrial activity is responsible for their multiplication at present; in the beginning, about thirty or forty years ago, it was necessary for them to prove their value. Either the world requires the technical expert to "find himself," as Kipling states, or, to extend the use of this phrase, the institution must "find itself." Either way will enlarge our vision of the possibilities of each. A new responsibility for the old-time graduates of such institutions is suggested by Prof. A. B. W. Kennedy, F.R.S., of England, in his address before the University College, London, Union Society. The men who have been away from their colleges a long time are well fitted, in his opinion, after the gaining of the necessary experience, to lecture to their younger brothers on special topics. It is self-evident that students could gain immensely by this practice, but where are the altruists to be found; and if found, must it follow that the capacity to lecture exists? Prof. Kennedy would meet with even greater difficulties in the United States than abroad in carrying out his suggestion. Sometimes a successful and experienced graduate will reappear in the old halls and lecture on a subject that represents his life work, but the occasions are very, very rare. Invitations to do so might have an effect upon some of our well known electrical experts, if extended by their old professors; but time and effort are so interpreted to-day on this side of the Atlantic that unusual influences would have to operate to make such an attempt more than a spasmodic effort. On the other hand, the electrical societies afford ample opportunity, in the way of technical knowledge, to those who desire to attend. An associate membership to the American Institute of Electrical Engineers would bring ample compensation to the student from the very class that Prof. Rankin believes should be heard within the college sanctums.

* * *

Electric Waves Directed Along a Single Path.

Privacy in communication is one of the necessities of our best signaling systems. However perfect in plan and operation such a system may be, its degree of usefulness can only be based upon its selectiveness. By usefulness is not meant the mere practicability, for experience has shown that what appears at first blush in inventive work as too much of one, frequently means too little of the other. The element of greatest promise in a new invention is its flexibility. Upon what this element depends is best understood by reference to a specific case.

In wireless telegraphy, for instance, no greater expectations could have been aroused than those whose crystallization was anticipated by dispensing with wires. To do away with wires and still to signal readily was at first glance akin to the supernatural. It would be no wild guess to state that not one-tenth of 1 per cent. of our so-called reading public have the faintest conception of how this is accomplished.

Their ideas are so wild and vague that it must be admitted their belief rests wholly upon blind faith. But when the fact became apparent that signaling through space without wires provided an opportunity to any one with an equivalent equipment to catch the message, the wonder abated in a large degree.

A better understanding of the necessary requirements of wireless telegraphy with respect to public opinion have now appeared. The most authoritative of the great daily papers in all lands keep in touch with the situation. With a perspicacity that almost amounts to intuition, they follow the brain work and experiments of our savants to the bitter end. Realizing the necessity for more privacy in wireless work, and the importance therefore of any experiments leading to a concentration of the waves employed, the news from Berlin reaching this city becomes doubly significant:

"An important improvement in wireless telegraphy is announced by Prof. Braun of Strassburg, the inventor of the system which bears his name.

"The professor has succeded in directing wireless electrical waves in a single direction. Up to now it has been possible only to transmit waves in all directions.

"Much energy is saved by the new invention."

The concentration of electric waves in the manner described, may lead to fundamental changes in the systems in vogue, Prof. Braun is one of our noted scientists, whose progressive experiments have been known to many interested students. A practical way of concentrating and directing electric waves as invented by him will be well worthy of study and experiment.

* * *

To Investigate Trade Conditions Abroad.

Action of much importance to electrical manufacturers and exporters has just been taken by the Secretary of Commerce and Labor, in accordance with the authorization contained in one of the annual appropriation bills passed at the last session of Congress setting aside $30,000 to pay the expenses of special agents to investigate trade conditions abroad with the object of promoting the foreign commerce of the United States. Under the terms of this provision of law Secretary Metcalf has dispatched five commissioners, two of whom will visit the Orient, while the others will go to Central America, South America and the West Indies. The commissioners are R. F. Crist and Prof. Hutchinson, who will visit the Orient; Charles M. Pepper, who was a delegate to the Pan-American Congress held in Mexico last year; Dr. Edward Bedloe, for many years a member of the consular corps, and Harry Burrell, a newspaper man, who will visit the countries lying south of us.

The commissioners will be attached to the Bureau of Manufactures in accordance with the terms of the act creating the Department of Commerce and Labor. In view of the limited appropriation, it has been decided that the funds at hand can best be spent in the Orient and in the Latin-American countries, rather than in the great commercial countries of Europe. It is generally understood, however, that Congress early in the next session will make a material increase in the appropriation for this work, which may make it practicable to enlarge the staff of special agents and assign several to Europe and Africa.

The instructions of the commissioners direct them to make a careful investigation of the conditions that have made it possible for American exporters to build up a large trade in certain lines, while equally energetic efforts to market other classes of merchandise have met with little or no success. Special attention will be given to an inquiry into the causes that have contributed to the success of our principal competitors in the markets in question, and all possible information on this point will be considered. In addition the commissioners will report upon transportation routes, docking and warehouse facilities, banking systems, international rail and water ways; and in the Orient a special study will be made of the obstacles in the way of the prompt transit of goods to interior points, the overcoming of which frequently adds greatly to the cost of merchandise before it reaches its final destination. Brief monthly reports will be made by the commissioners, and they will also prepare a general preliminary report for transmission to Congress in December.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

In pursuance of its plan for the extension of auxiliary electric traction lines the New York Central management some time since created a special department for the direction of these lines. William K. Vanderbilt, Jr., is now in charge of this department.

◆

The electrification of the railways between Stockholm and Vartan in Sweden, has reached completion, the first trials over the line having been made this month. The power station has been erected at Tonteboda, two De Laval turbines being installed. If the trials prove satisfactory it is probable that the local passenger lines between Stockholm and Jarfa will be taken in hand. The overhead system is employed. The above lines are State-owned and it is said that the private railway companies of Sweden are watching the experiments closely with a view to adopting electric traction. The presence of abundant waterfalls in Sweden increases the probability that electricity will be substituted for steam on all the lines of the country in the near future.

◆

Prof. Charles P. Matthews has been placed at the head of the School of Engineering at Purdue University, Lafayette, Ind., with the title of professor of electrical engineering and director of the electrical laboratory. Prof. Matthews succeeds Prof. W. E. Goldsborough.

◆

The Connecticut Senate has rejected in concurrence with the House the bill designed to allow of the incorporation of independent telephone companies, and also the bill raising a commission to investigate the action of telephone companies now doing business in that State. The action is regarded as a victory for the Southern New England Telephone Company.

◆

It is learned on good authority that the street railway companies of Chicago are preparing to file a bill which will challenge the right of the city to use any of the lines as a nucleus for Mayor Dunne's municipal street railway system. No one is more anxious than the controlling interests in the traction properties of Chicago to give the citizens of that city a first-class local transportation service and many close observers believe that they will be given an opportunity to do this sooner than is generally expected, and that in the meantime it will be proven that municipal ownership is not feasible at the present time at any rate.

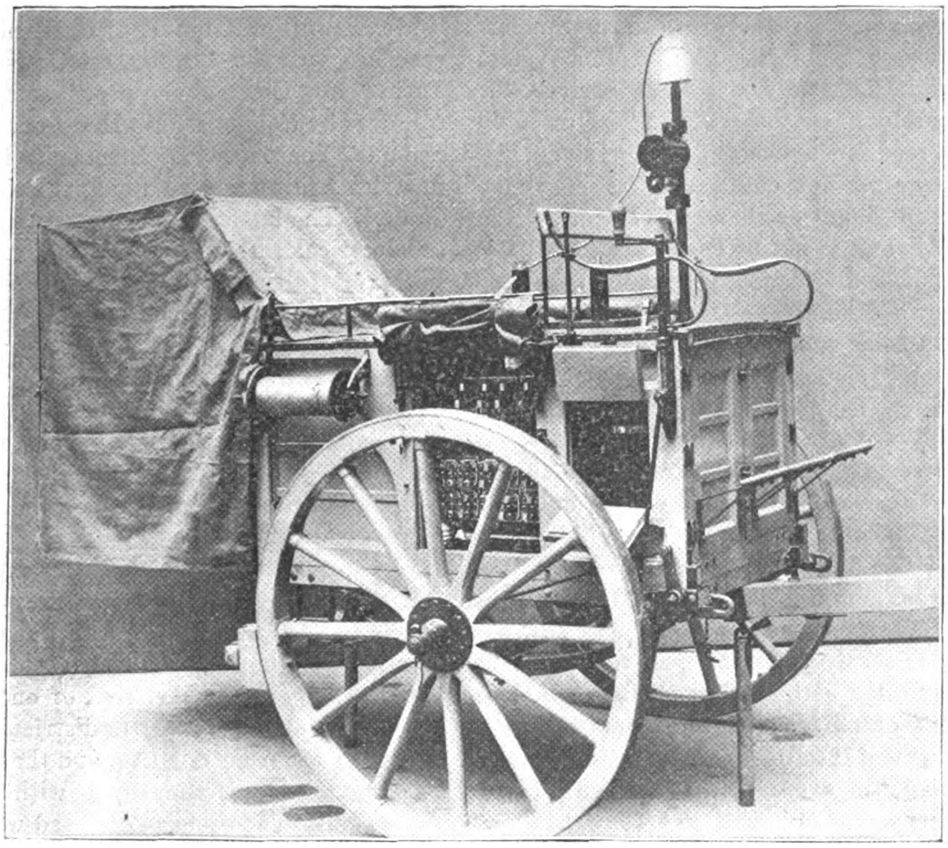
◆

The electric roads controlled by the New York, New Haven & Hartford Railroad Company are being tested by an automatic testing car, the lines between Stamford, Conn., and New Rochelle, N.Y., having been gone over by the car last week. The car makes a thorough test of the copper wires connecting the rails, and also as to the general condition of the road. The defects are recorded automatically as the car goes over the tracks. The car has been operated on over 10,000 miles of electric road in the West. The car is in charge of Clarence M. Boyden, superintendent of inspection for the Electric Railway Company of Cleveland.

LATEST GERMAN WIRELESS TELEGRAPH EQUIPMENT AS USED BY THE RUSSIAN ARMY AND NAVY.

BY FRANK C. PERKINS.

The present Japanese-Russian War has demonstrated the fact that wireless telegraphy is not only of great value in the navy, but wireless field telegraphy is also of great importance in military manœuvres as it is necessary that a fast and reliable means of transmission of news be maintained between the troops. The accompanying illustration shows a new German wireless military telegraph outfit supplied not only for use by the Russian armies but also in the military departments of Austria and Germany by the Gesellschaft fur Drahtlose Telegraphie of Berlin. This equipment is a combination of the Braun-Siemens and Slaby-Arco systems and enables the military officials to transmit their commands over long distances up to 150 km.



German Military Wireless Telegraph Outfit, Showing High Tension Side of Apparatus Car.

This transportable station consists of three cars having two wheels, each of which weighs about 600 kg., and is drawn by horse or mule. They are utilized as a power car, an apparatus car, and supply car. The station is fitted up for two wave lengths, viz., for a short wave of 350 meters, and a long wave of 1,050 meters. The aerial wire is the same for both wave lengths. With the short wave it oscillates in ¾, with the long one in ¼ wave. The outward balancing of the aerial wire takes place in the first case by a counterweight of about 6, in the last case by one of about 24 cubic meters copper gauze which are stretched out to a height of about 1 meter distant from the earth.

To carry the aerial wire kite balloons or linen kites are used. The first have a capacity of about 10 cubic meters and a driving power of about 3 kg.; the second a useful wind surface of 1.1 cubic meters, so that it is already possible with a light wind owing to the economy of gas to make use of these.

The power car contains a benzine motor of about 4 hp. coupled direct to an alternating current generator of about 1 kw. useful effect and the exciting dynamo. The circulating of the water, which is used for cooling the motor, is done automatically by a small cog-wheeled pump, and the water is cooled by a ribbed pipe system and a ventilator. The requisite benzine for the working is driven into a reservoir close to the water cask whose capacity is about 30 liters. The capacity is measured in such a manner that it will suffice for a continuous telegraph service of about 30 hours.

The igniting of the motor is electric, storage batteries being utilized which are automatically charged by the exciting dynamo of the alternating current generator. A cable drum is provided on the outside of the car to haul in the balloon, a conical friction clutch being employed in connection with the same. The apparatus car is divided by a partition into two parts, one of which contains the receiving apparatus and the other the transmitting apparatus. The high tension apparatus including the transformer, spark gap, and its accessories, are mounted in the front section while in the back part of the floor of the car are located the Morse register and Morse key as well as the receiving apparatus carefully supported upon springs. The supply car carries the gas reservoirs each of which hold 5 cubic meters at a pressure of 120 atmoshperes, as well as the balloon, an extra gasoline reservoir and various extra repair parts. In transmitting messages with the long wave the whole of the high tension transformer windings are switched in. To prevent the receiving apparatus from being connected up by mistake while messages are being transmitted a special switching arrangement is provided so that the receiver batteries, coherer, and other receiving apparatus is automatically cut-off when the transmitting equipment is connected with the antennæ. It is thus impossible for the transmitting apparatus and the receiving apparatus to be connected to the aerial wire at the same time. There are three ways for obtaining a diminution of intensity at the receiver, including a regulation through the coherer, an alteration in the connections of the receiving transformer, by moving the primary coil upward so that the secondary coil embraces but very little, and by the non-laying of the counterweight at the transmitter or receiver. It is claimed that the Schloemilch electrolytic detector is one of the most perfect yet constructed for wireless telegraphy and is very sensitive as well as very simple in construction.

MUNICIPAL ELECTRICAL ENGINEERING IN ENGLAND.

(From our London Correspondent.)

The annual convention of electricity works engineers and councillors connected with the English Municipal Electrical Association, was held at Edinburgh, Glasgow and Aberdeen from June 27 to 30. The president for the year is Mr. Frank A. Newington, the city electrical engineer of Edinburgh, who opened the convention with an address touching a number of the financial, commercial and engineering problems that have during the past year or two been troubling those responsible for the control of municipal light and power plants. The depreciation of plant, and the provision that ought to be made in respect thereof before declaring profits, was referred to at considerable length. Up to the present the Association has regarded the average life of an electrical plant as being 30 years. but the Government through the Local Government Board, has lately been showing that this idea has not its sanction, and that shorter periods will have to be adopted when making financial provision respecting their undertakings. Mr. Newington recommended engineers and others to remember that beyond the replacing of small units by large ones, and the likelihood that types of machinery might change very much during a period of 25 years, they should build up reserves in case they had to face some altogether new form of artificial illuminant. The improvement which had been made in incandescent gas mantles has made that form of lighting greatly in favor for side street purposes of late, and Mr. Newington remarked that just at present there did not seem to be any form of electric lamp that could quite compete with it, though there were several new forms, more or less in the experimental stage, that appeared to be very promising in regard to economical qualities. While enormous developments have taken place during the last 10 or 12 years in the manufacture of generating machinery "very little advance had been made in the wiring of houses or other buildings for electric light."

It was one of the station engineer's great aims to utilize his machinery during the daytime as much as possible, the sale of electricity at low rates for power or heating being adopted as a means to this end. But, said Mr. Newington, there is a weak point in this arrangement. The motors are used during the time of maximum lighting load during the winter months, and therefore, additional machinery must be provided for them. If they could arrange for the motors to be switched off during the two or three hours of maximum load for lighting in the four winter months, extra machinery would not be required, and so a very low rate could be charged. Such a system is being adopted in Edinburgh, and is also in force in a few other cities. The load factor of motors is generally extremely low, and when fixing the price of electricity for power purposes, it ought to be remembered that the cost of generating electricity is in inverse proportion to the motor load factor. The president suggested that engineers should find out how the motors connected to their systems are used during the hours of maximum lighting load in the winter months.

The first paper to be read was on "Load Factor—Its Effect Upon an Electricity Station," read by Councillor Alex. Sinclair, of Swansea. By means of various curves and tabulated data, he demonstrated the commercial and other advantages accruing from an improvement in the load factor by the on-coming of a good public lighting supply, tramway load, and the dispensing of power on a large scale to small users at cheap rates. The maximum demand system of charging sometimes becomes an obstacle to progress because the ordinary individual either cannot or will not try to understand it; therefore Mr. Sinclair threw out a suggestion that if a system simple in itself could be arrived at, whereby a customers's load factor could be readily and easily ascertained, his charge per unit could then be regulated by a discount on its rated price.

"Street Lighting" was the next topic considered. Mr. E. E. Hoadley, the city electrical engineer of Maidstone, referred to the competition of gas which has become increasingly keen during the past year in England. At Maidstone he has employed the Nernst lamp somewhat extensively for several years past, and his paper contained a good deal of data respecting the results obtained. Although still far from perfect, he regards the Nernst lamp as having been the savior of the street lighting business for the electrical world. The greatest fault he has to find with the Nernst lamps is their want of uniformity. This is most apparent in the life of the burners, as, although the average life obtained in Maidstone was 676 hours, yet they had had many burners in use for over 1,000 hours and several between 2,000 and 3,000; they had also had many which had failed before they had reached 100 hours burning. The want of uniformity was also noticeable in the way in which the candle power fell off; some burners did not appreciably drop for quite a long life, while others lost a great deal of their light-giving properties in a very short time, and would then last in that condition for a long while. As the outcome of his practical experiments, Mr. Hoadley suggested certain improvements in the manufacture of the lamps; that the burner should be made a more mechanical job, and that the actual filament when broken should be capable of easy replacement by the user at a cost of a few pence, instead of, as at the present time, the whole burner, including the heating coil and its supports and connections being thrown away, at a cost of nearly 2s. He thought that the ideal lamp for the lighting of the less important streets would be found eventually in a small flame arc lamp, taking about 100 watts, and having a magazine feed so that it would burn for some 60 or more hours without attention. The manufacturer who produced a lamp of this description, or something of equal efficiency, would reap a rich harvest. Engineers were urged to give careful thought and trials to new lighting appliances such as the mercury vapor, Osmium and Tantalum lamps, and not to always wait for the results of some one else's experiments.

Mr. Hamilton Kilgour, of Cheltenham, read a paper on "Notes on Costs and Tariffs for Electric Supply," and was followed by Councillor W. Hodgson, with one on "The Supply of Electricity in Industrial Areas from a Municipal Point of View." The latter paper contained little of electrical interest, its points having been very fully dealt with during the past five or six years, since the idea of big companies for power in particular industrial areas was first mooted in England. What was of interest in the paper was the councillor's lecturing of his municipal brethren on their failure to look properly after the power consumer in years gone by.

The question of municipalities extending their mains to outlying areas was raised by Mr. A. B. Mountain, the chief electrical engineer of Huddersfield, who discussed the necessity, etc., of one authority extending supply to districts governed by other authorities, and the engineering problems connected with such extensions. The other paper read was by Mr. A. R. Sillar, the city electrical engineer of Colchester, whose endeavor was to give a few hints to these station engineers who had never seriously considered the introduction of free wiring and the supply of current by means of prepayment meters into their towns.

During the course of the convention, visits were paid to the electric power stations of Glasgow, Edinburgh and Aberdeen, and that of the Clyde Valley Power Company, which was so recently opened at Yoker, near Glasgow.

* * *

The development of the marble quarrying industry in this country has been remarkable and coincident with the utilization of electrical machinery. In Vermont alone it is estimated that more than $5,000,000 is invested in quarry machinery and other equipment, a large portion of which is electrical.

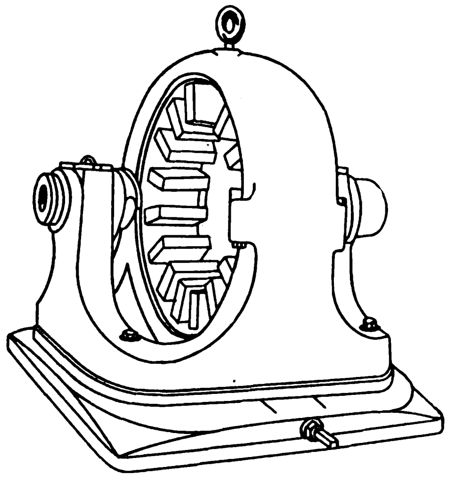
ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

THE TRANSMISSION OF POWER.

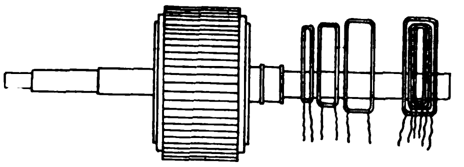
Features of Single-Phase Alternators.—To preserve a uniform pressure a compensating winding is employed in single-phase alternators. It consists of a winding situated on the armature which acts as a secondary to a few turns of the main armature winding. This current is rectified by means of a commutator attached to the shaft. It is led from the brushes pressing upon the commutator to compensating field coils.

The Compensating Coils.—The regulation of the alternator is thus accomplished as easily as in a direct current machine. In fact, in this respect, the alternator is practically a multipolar generator when part of its energy is commutated and utilized for the fields. The main energy of the fields is that received from the exciter. The regulating portion of it is received from the armature itself. Compensating coils are thus equivalent to the series coils of a compound-wound machine. This flexible combination of the two methods has made single-phase alternators thus equipped very successful. The shifting of the brushes on the commutator will be sufficient to meet and correct voltage variations. The brushes may be set when the voltage decreases, or when it rises, or to meet a certain condition of overload otherwise impossible to adequately control. The pressures developed by standard machines run from 1,100 to 2,200 volts, the alternators about 16,000 per minute. The fields are made of thin sheet steel, very soft and of high permeability. These plates are held in a mould when the frame is being cast. The poles and the frame are thus incorporated with each other. Joints are avoided by this means and a higher efficiency and better regulation results. The armatures of this class of alternators are slotted and receive a coil very readily, the teeth being cut with parallel sides. The windings are easily held in place by fiber wedges which are removable when examination or repairs to armature coils are necessary.

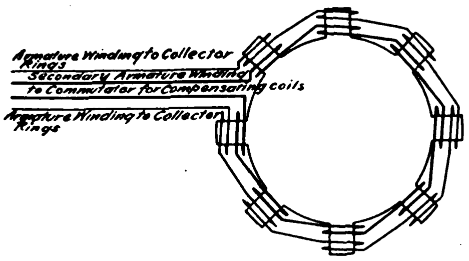


Field for 120 kw. Alternator.

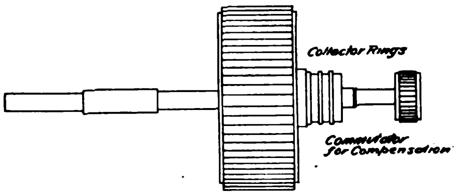
The appearance of the field and armature of a 120 kw. single-phase alternator is shown in the illustrations. The principle of the winding for compensation is also shown. Some data relating to the capacity, speed, number of poles, etc., is given in the following table:



Core and Coils for 120 kw. Single-phase Alternator.


Armature Winding to Collector Rings
Secondary Armature Winding to Commutator for Compensating coils
Armature Winding to Collector Rings

The Two Windings of an Alternator Armature which Operate Compensating Coils.

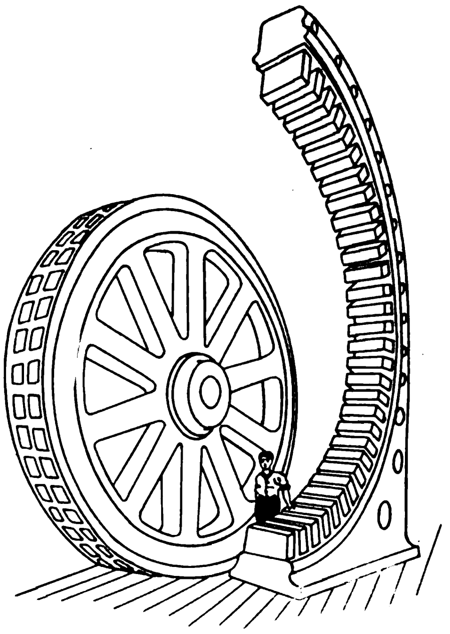


Armature for 300 kw. Alternator.

DATA CONCERNING 16,000 ALTERNATION SINGLE-PHASE ALTERNATORS.

Capacity in kilowatts.	No. of poles.	Belt speed in feet per minute.	Weight in pounds.	Revs. per min.
45	10	4,607	3,230	1,600
60	12	4,543	4,180	1,335
90	14	4,488	6,430	1,145
120	16	4,450	7,970	1,000

Engine Type Alternators.—For large plants where heavy currents are transmitted or distributed at a comparatively high pressure, the flywheel of the engine and the armature of the single-phase alternator are built in one. The vis viva of the armature is sufficient to form the function ascribed to the flywheel proper, without detracting in any way from the efficiency or capacity of the plant. The armatures in this case are built up of a spider upon the rim of which the laminated iron of the armature is secured. A huge flywheel thus results which serves as an alternator armature. This idea originated in Europe, particularly in Germany and Austria, and is satisfactory as a saver of space and expense. The coils are formed before insertion into the slots. By this means no particular work is required to make substitutions for injured coils and only ordinary care is necessary in assembling the armature. Bar winding is sometimes employed, and an illustration of a sample of this form of winding is shown. The idea is carried out also in a reverse manner, the poles revolving and the armature remaining stationary. The gigantic nature of these operations can be best understood by examining a sketch showing the comparative size of an armature and field and a man. The machine in this case represents a 1,500 kw. generator with an armature of the character described. The armature has not been assembled and the laminations of the armature have not been attached. Each year machines are built larger and larger to meet the demand for more power, due to the projection of great power transmission and street railway enterprises.

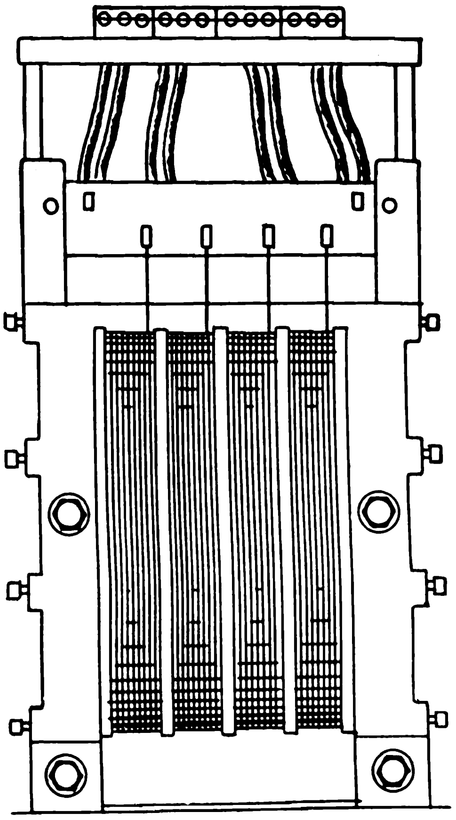


Armature Spider and Half of Field for a 1,500 kw. Rotating Armature Alternator.

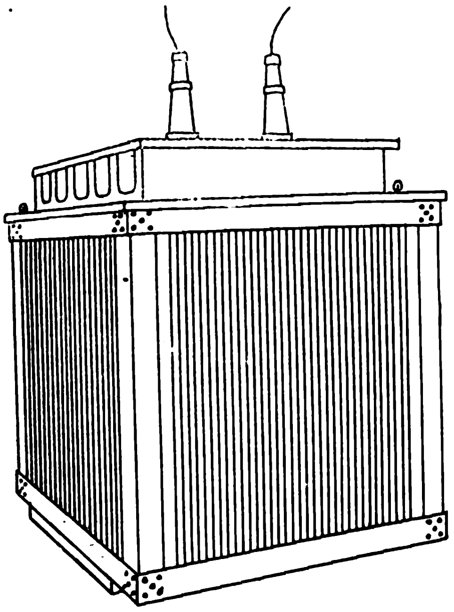
DATA OF ENGINE TYPE ALTERNATORS.

Capacity in kilowatts.	Alternations.	Revolutions per minute.
300	7,200	130
400	7,200	150
500	7,200	144
750	7,200	90

High Voltage Transformers.—The introduction of the polyphase motor of Tesla's design and the development of a high insulation, high-pressure transformer went hand in hand with the sudden augmentation in the number of successful power transmission plants installed. High pressure transformers came into vogue to meet a necessary requirement in transmission plants. They run in size from about 10 to over 500 kw. capacity. The obtaining of high insulation is accomplished by building up both primary and secondary in the form of a series of flat coils of few turns per layer but many layers, and plunging all into oil. According to the data supplied by the manufacturers of these transformers, the advantages of this construction is as follows:



500 kw. 30,000 Volt Transformer.



Case for 500 kw. 30,000 Volt Transformer.

First—It divides the total EMF. between several coils, reducing proportionately the strain within an individual coil.

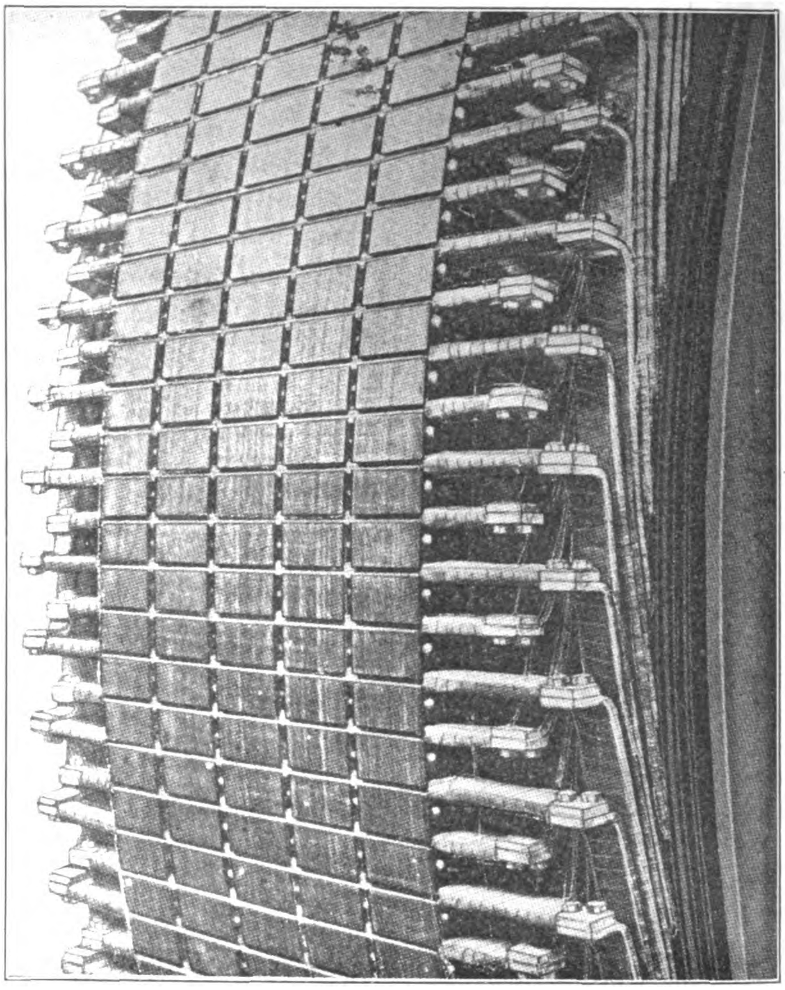
Second—It divides the EMF. in a single coil between many layers, thus reducing the potential between adjacent layers.

Third—It enables the coils to be spread apart at the ends so that a very large surface is exposed to the oil, thus providing ample radiating facilities and most thoroughly insulating the bent part of the coils.

Fourth—The regulation of the transformer is greatly improved.

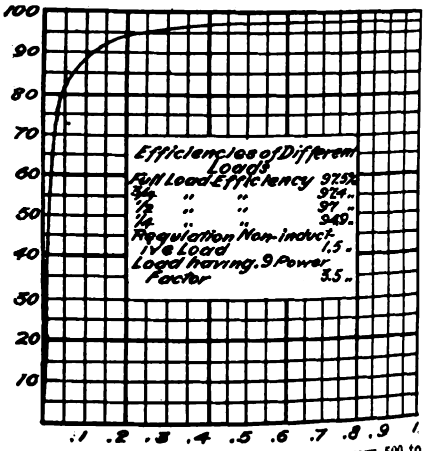
Fifth—The windings may be connected in series or in multiple giving a wide range in EMF.

Sixth—In case of damage to a coil another one may be substituted without trouble and without returning the transformer to the shop.



Portion of a Bar Wound Rotating Armature. (Referred to on preceding page.)

The use of oil is admitted to be the solution of the insulation problem when discretion is employed in the design of the coils themselves. It insulates, and also conducts away excess heat very rapidly. The difficulty of handling 30,000 volt transformers is self-evident in case of temporary injury or overload. The construction therefore must be of the best character to preserve its integrity under the strain of heavy service. The development of heat arising from the copper wire can be limited by designing the coil to have a small C^2R loss. The heat due to hysteresis and eddy currents in the core can only be controlled by fine lamination and the use of a very high grade of soft iron. The iron has been shown to deteriorate through use and become in a sense inefficient. It takes more energy to magnetize it under these conditions than iron which a test has demonstrated to be free from this phenomenon. To prepare iron for use in transformers a special treatment is necessary. Neglect of this will lead to a heavy waste of energy in the transformer a short time after being put into service. Curves showing the relationship between efficiency and load will indicate the rapid rise in efficiency with a relatively light load. They also serve to show the tendency to rise or fall in efficiency with an increasing load up to the full 100 per cent. capacity.



Efficiency Curve 150 kw. Transformer; EMF. 500 to 15,000 Volts; Alternations 7,200 per minute.

A transformer of large size, though efficient, will waste a great deal of energy which appearing as heat must be disposed of. A 100 kw. transformer, for instance, wastes 5 per cent. or 5 kw. This amount of heat will act destructively upon the transformer in the course of time and seriously affect its life. Radiating ribs are therefore supplied to the containing vessel or case, facilitating the removal of the heat. Corrugations are also employed to increase the surface for the same purpose. High pressure, self-cooling transformers for heavy service are now employed extensively on two and three-phase lines as well as for single-phase. Some interesting data in given in the following table in relation to the capacity, voltage, weight and floor space of transformers of the self-cooling type. These are used exclusively in transmission plants when the high pressures employed require substantial and reliable construction to insure continued operation:

DATA OF SELF-COOLING TRANSFORMERS OF 7,200 ALTERNATIONS.

Capacity.	Volts.	Total weight in lbs.	Floor space.	Height in inches.
10 kw.	30,000	1,485	37 x 23	60
50 "	30,000	2,328	38 x 29	70
75 "	30,000	4,400	51 x 38	70
100 "	2,000	3,850	" "	50
	10,000	3,975	" "	50
	15,000	4,150	" "	50
	20,000	4,950	" "	72
	30,000	5,125	" "	72

Two additional cases arise in power transmission plants; first, where two-phase currents are to be transformed into three-phase and three-phase into two-phase, and second, the employment of transformers in connection with rotary converters for the special purpose of meeting voltage changes without difficulty. In this latter case, the call for changes of pressure in the direct current would necessarily mean proportionate changes in the alternating current. A transformer with a means of changing the ratio of the primary and secondary winding would cover this situation successfully. By bringing connections out from the various sections of the transformer to an index and dial, regulation in this respect is readily secured. In the table of self-cooling transformers, the additional figures given show, with an increase in pressure from 2,000 to 30,000 volts, an increase in weight of from 3,850 to 5,125 pounds. The floor space does not change but the volume does to the extent of the increase in height. Transformers of higher pressure than these would also increase in weight as indicated in the rise in pressure from 2,000 to 30,000 volts, and the increase in weight corresponding to this rise. Potentials of 100 and 150 thousand volts are of service for special insulation testing and are produced by transformers built on the same lines as these.

WRINKLES.*

EDITED BY H. C. ABELL.

A Simple Remedy for Preventing the Damper Regulator from Working from Extreme Open to Closed Position.

This consists of a small plate X, about 7 inches in diameter, clamped on end of weight beam K; two pulleys, S and R, placed respectively above the plate X and the other close to the damper chain H. The small chain G to run from top of weight F over R and S to chain J, which consists of about 18 inches of chain made of 0.75-inch iron.

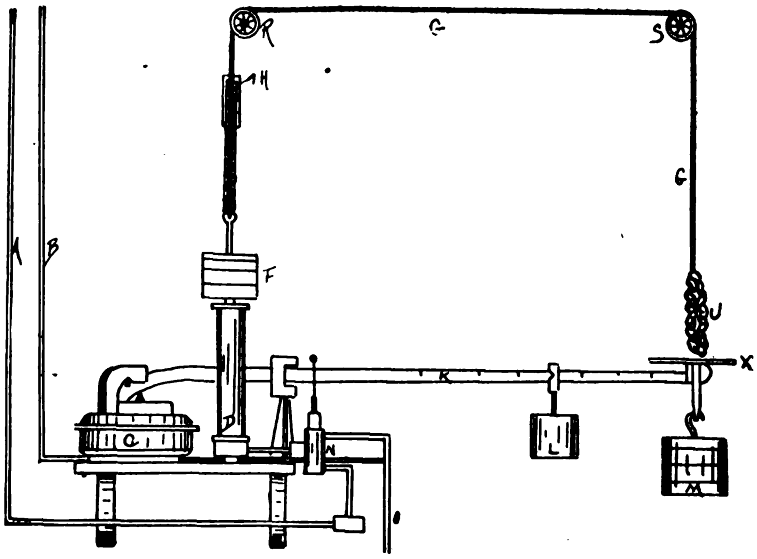


DIAGRAM OF CONSTRUCTION.

When pressure increases on boilers and raises lever K, also weight F, chain G feeds over the sheaths R and S, landing chain J from plate X little by little as the position of weight F is changed, thereby increasing the effect of weight M as damper closes, which will cause the damper to stop at several intervening points between wide open and closed positions, with a variation in pressure that will not be noticeable on the steam gauge. As the steam pressure falls on the boilers and weight F descends, chain J will be lifted from plate X, stopping the motion of the damper regulator at several points between the open and closed positions of damper.

This permits the regulator to hold the damper partly closed at all times when the boilers are not pulling at their maximum capacity, and thereby regulates the draft to the exact amount required.

EDISON ELECTRIC ILLUMINATING COMPANY, West Chester, Pa.

A Three-Phase Booster.

A three-phase transmission line is fed from central-station 'bus bars through raising transformers. It was found desirable to raise the pressure a few per cent. above that given by the raising transformers. This is accomplished by means of three single-phase transformers, with primaries wound for the 'bus bar pressure and a lowering ratio such that the secondary pressure gives the desired boost. This ratio being 10 to 1, a 10 per cent. boost is obtained by connecting the primaries star fashion, the secondaries being in series with the respective legs of the circuit. With the primaries connected delta fashion, no change being made in the secondary connections, the boost is about 15 per cent.

The primaries should not be switched in an ordinary manner from one arrangement to the other while the circuit is loaded, since the large current flowing in the secondary, with an open primary, produces dangerously high pressures in the primary coils.

If it is desired to change the percentage of boost with variations in load, this may be accomplished by means of a special switching device which will short-circuit the secondaries immediately upon opening the primaries, and which places the secondaries again in circuit immediately before closing the primaries in the other way.

With transformers of the three-wire type and some auxiliary switches it is possible to obtain four different percentages of boost, as 5, 7.5, 10 and 15 per cent.

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*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

J. M. WEED, Denver, Col.

EXTERNAL CAUSES OF SPARKING IN DIRECT-CURRENT MACHINERY.*

BY SYDNEY WOODFIELD.

The following article deals with the sparking in direct-current machinery, due to external causes, that is to say, due in no way to defective design. As a rule, a small amount of sparking for a short time is not detrimental, but owing to the roughening caused to the commutator the effect is cumulative, and it becomes, therefore, necessary to eliminate the cause of the sparking as soon as possible. White sparks are generally small incandescent particles of carbon torn from the brushes by a rough commutator, while bluish-green sparks indicate that damage is being done to the commutator segments. In railway motors, owing to their reversibility, the brushes must be fixed permanently at the neutral point, and the field cannot be utilized for reversing the current in the short-circuited coil; the commutation is, therefore, hardly ever sparkless at full rated load, and the commutator needs considerably more attention than is required for an ordinary unidirectional motor. It has been found that hard crystalline brushes (which have a lower contact resistance and lower coefficient of friction), soaked in hot liquid vaseline, give excellent results.

The following are the more common causes of sparking:—(1) Dirty commutator; (2) Weak field; (3) Excessive overload; (4) Vibration; (5) Incorrect location of brushes; (6) Unbalanced magnetic circuit; (7) Defective commutator or armature.

1. This is, perhaps, one of the most common causes of sparking troubles, and is generally due to the oil wells being allowed to overflow. The carbonized oil, with probably steel dust from the bearings, copper dust from the commutator and carbon from the brushes, forms a plastic mass which makes sparkless commutation impossible. Moreover, it forms a conducting medium between commutator bars, which can readily be seen by a number of sparks between bars. Finally, this conducting medium will form a short circuit from positive to negative brush. This dirty condition will also cause considerable heating of the brushes and commutator, and the heating may rise to such an extent as to cause damage to the insulation of the machine. In larger machines operated by cross compound engines, oil on the generator is fairly general, owing to the spash from the eccentrics; great care should therefore be paid to the oil guards, which require to be of solid construction owing to the suction caused by modern methods of ventilating armatures. To remove the oil, etc., the commutator should be cleaned with a rag soaked in benzine, and afterwards wiped over with a clean dry rag, a little vaseline being used for lubrication.

In a new machine, after the brushes have been bedded down by drawing a piece of sandpaper backwards and forwards face upwards between the commutator and the brushes, the commutator should be cleaned up with a clean rag dipped in paraffin, until it no longer picks up further carbon dust, and then thoroughly wiped over with a clean dry rag. It is always advisable to run a new machine without load for some time, in order to allow the brushes to wear down and make good contact, as good commutation cannot be expected unless at least 75 to 80 per cent. of the brush surface is in contact. Sparking may also be caused by the brushes not sliding freely in the boxes. If the sides of the brushes are rough, they should be sandpapered, and the inside of the boxes should be wiped out with benzine to prevent sticking. The brush-holders should be staggered on the studs so as not to wear grooves in the commutator. In rotary converters, an end-play device is usually supplied, which constantly oscillates the armature backwards and forwards. The Bullock Co., in its engine type generators, provides a mechanism for slowly carrying the whole brush rigging on trunnions backwards and forwards lengthwise on the commutator to prevent grooves forming. This also prevents any particular spot from aggravating the same brush or brushes, and it is usually found that the movement of the brushes removes the spot that causes the trouble.

Care should be taken to see that the springs bear on the center line of the brushes and that all the brush tips are in a straight line. It may sometimes happen that sparkless commutation cannot be obtained in any location. Alternate brushes on each stud should, if possible, be set about one bar in advance (this is equivalent to increasing the width of the brushes); sparkless running will then generally be obtained. Most modern machines have two or more brushes per stud, which can move independently. In some of the earlier machines only one brush per stud was provided, and, consequently, the slightest irregularity would cause excessive sparking.

2. A weak field is often caused in a new machine by one of the field spools being reversed; this will cause bad sparking. The polarity may be tested with a compass needle, or, if this is not handy, a small piece of iron may be held across the tips of adjacent poles; when these are of opposite polarity, the iron will be held strongly and will take considerable force to remove it, whereas, if they are of the same polarity, the pull will be almost negligible.

Akin to the above is connecting the series winding in opposition to the shunt windings; in a generator this may easily be detected by the fall in pressure as the load comes on. This fall will be considerably more than if the machine were a purely shunt wound one, whereas if the winding were connected correctly, the voltage would, of course, rise. In a motor which is designed to be similarly wound, the speed will rise if the series winding is connected in the reverse direction, whereas if it is connected to act with the shunt field, the speed will drop more than on a shunt motor. In a differentially wound motor the speed should remain practically constant for all loads.

An internal short circuit in one of the field spools will also cause a weakened field, since a portion of the turns are cut out. This will generally be detected by that particular spool being cooler than the rest, or by taking the potential drop across each spool by means of a voltmeter. The drop across the defective spool will be less than across the others. It is obvious that owing to the unequal field strengths under different poles, sparking will ensue. Sometimes the connectors between spools are not properly tightened up and vibration causes the wire to fall out, thus breaking the field circuit and causing considerable damage. The screws should be firmly driven and a spot of solder dropped on to prevent them from becoming slack. Many motors have to run on grounded circuits; care should therefore be taken with the insulation, especially between the shunt and series winding, since it has to stand the full voltage of the circuit at starting.

Unequal field strength under the poles may also be caused by not bolting up the poles or pole shoes tightly; this fault, however, will usually be found when centering up the armature, but all joint surfaces should be carefully cleaned and, except in the case of electrical ones, coated with a thin layer of oil, special care being taken with the pole-pieces and halves of the magnet frame.

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*From the "Electrical Review," London.

Low applied voltage in the case of a motor will cause sparking if the drop in voltage is serious; moreover, as the makers usually have only one field winding for fairly wide limits, rating the speed up or down about half way in proportion to the increase or decrease (as low voltage on fields tends to increase the speed and on armature to decrease the speed, and vice versa) in voltage, it often happens that one may get as much as 20 per cent. low voltage on the machine and at the same time expect to get full rated load from it without sparking.

In a generator the poor regulation of the governor causing a falling off in speed gives a low voltage and, consequently, a lower density in the air-gap; this, as above, causes sparking owing to the neutral point shifting.

Shunting the fields of series-wound motors so as to give a higher speed is now rarely used, although it was quite common with railway motors at one time, but considerable sparking was caused by its use when going up hill, for which purpose it was never intended. On a grounded circuit a short-circuit to ground of one of the field spools will weaken the field. This fault is quickly located if the grounded coil is near the line side as the spools in circuit will get excessively hot; if near the earth side, the same test as for a shorted coil should be applied.

3. Excessive overload on a machine, whether generator or motor, will cause sparking. As is well known, the coil under commutation must be in a field of such strength as to generate an EMF. equal in value but opposite in direction to the EMF. of self-induction produced by the reversal of current in the coil. As a larger current is drawn from the machine, it is clear that a more instense field is required, but this larger current produces an armature flux which distorts the field and makes it lead the brush position and at the same time it also weakens the field, hence the brushes must be given a further lead until ultimately a current will be reached such that sparkless commutation is impossible. Modern machines allow considerable latitude in the location of the brushes for a definite load, hence, under normal conditions, the brushes are set fairly well forward, so that when an overload comes on there will be very little sparking, but should the overload still be increased, it will be impossible to prevent it. Care must be taken, however, to guard against too much forward lead, since, should the station circuit-breakers open, the machine would spark badly at no load or might even flash over.

The current density in carbon brushes should not exceed 30 amperes per square inch at full load and the tension about 2 lbs. per square inch. A greater pressure will cause a considerable increase in brush friction and consequently heating, besides undue wear on brushes and commutator. It, furthermore, leads to glowing and selective commutation. A heavy overload or short circuit on a shunt-wound generator or motor obviously acts as a low resistance shunt to the field winding and, therefore, the machine loses its field. In a generator, this will automatically relieve the machine, but in a motor, if not efficiently protected, it would result in a burnt-out armature. Care should be exercised in selecting a motor for certain machine tools, etc. Whenever the load is at all intermittent, a compound-wound motor is preferable; for instance, circular saws, pumps of the bucket type, air and ammonia compressors, etc., as if a shunt machine is used there is sure to be trouble from sparking. This matter is, however, governed somewhat by the design of machine, and the material of the magnetic circuit. A material possessing great coercive force is, perhaps, preferable.

4. Vibration is more frequent with small machines, and, in any case, it is detrimental to the proper operation of any plant. In direct-connected sets it is usually due to unbalancing of the engine, knocking of the big ends, badly designed foundations or footings, etc. The cause of the vibration should be immediately localized, as it will cause sparking and a general deterioration of the plant. In belted machines an unbalanced armature or pulley will cause trouble, but more often the cause will be found in a bad joint in the belt, which will cause a considerable amount of sparking every time the joint passes over the pulley. Belts should, therefore, be dressed smooth, and should be run with, not against the lapping; this will effectually stop jarring. The crowns of driving and driven pulley should be alike, as otherwise wobbling of the belt will result. A back and forth movement, due to unequal stretching of the edges of the belt, will also tend towards vibration.

5. Usually the makers of machines mark the correct position of the brushes on the yoke, and unless the machine is operating under abnormal conditions, this location should not be departed from. Under normal conditions in multipolar machines the brushes should be set exactly equidistant around the commutator and parallel to the segments, and the brush boxes should be exactly the same distance from the surface of the commutator. It sometimes happens—but very rarely—that better commutation can be obtained by setting each brush stud individually; this is generally caused by the poles not being spaced accurately magnetically, although they may be mechanically. With angular carbon brushes care must also be taken to see that they are slipped into the boxes the correct way. If the brushes of one stud are reversed sparking will ensue, since they are not equidistant around the commutator.

6. The field frame in all machines of the multi-circuit type must be concentric with the armature, i. e., the axes should coincide so that the air-gap will be the same all the way round; this should be carefully tested, turning the armature round into different positions in order to eliminate errors caused by the armature not being truly wound. If the air-gap is not the same there may be sparking even on light loads. The armature must also be set so that the center line of the armature horizontally coincides with the center of the poles, although sometimes this will be different. Most makers supply machines of large size with multiphase equalizing rings, these rings automatically equalizing the potential difference between brushes without regard to the centering of the armature; but it must be borne in mind that this equalization is only obtained at the expense of current flowing between the high and low sides, and therefore, as stated above, due care should be given to centering; this may be tested by measuring the pressure across each pair of brushes, all others being raised at the time and the speed remaining constant, and equalizer rings being of course disconnected. Obviously, in a two-pole machine, or a multipolar one with a series-wound armature, this fault cannot exist. Some makers allow a little wider air-gap at the bottom on new machines, so that when the bearing brushes get worn the armature becomes central.

7. On large new machines, more especially those having commutator split spiders or sectional clamping rings, it may be necessary to tighten up the commutator. When this has been done it should be frequently smoothed with fine carborundum sandpaper, and during the first month or so the segmental rings should be watched and kept tight until the commutator bar gets a firm bearing. It is advisable to do this tightening after a good long run, when the machine is hot. Sometimes a commutator may require skimming up in the lathe, but more

often it is unnecessary to do this, as good results may be obtained by stoning, i. e., by using a block of sandstone about 4 to 6 inches by 8 to 10 inches; this block should be held in a wooden holder of convenient shape, and the long surface of the sandstone made to fit the arc of the commutator. A stone made in this way will usually reduce high bars, as it will not follow inequalities in the commutator. After this has been done, a sheet of fine sandpaper should be used, and a buff finish imparted by reversing the sandpaper. This method saves considerable time and money, and insures sparkless commutation; but care must be taken to protect the armature windings and commutator leads from the grit, carbon and copper dust. If the commutator is eccentric, which is usually due to loose bearings or loose bearing pedestals, the commutator must be turned up true in the lathe. A short circuit between two bars of a commutator will easily be recognized by the blackening of the bars, and also by abnormal heating of the coils connected thereto. Sometimes it may be caused by a piece of metal getting between the bars, or by a loose piece of solder inside the commutator. More often it is due to sparking from some cause burning the mica; the spaces then get filled with carbon and copper dust, thus forming a permanent short circuit. The remedy is to clear away all dirt and scrape the space clean, and fill it up with sodium silicate and mica powder mixed to the consistency of paste. An open-circuited coil will cause excessive sparking; when running, the commutator will appear to have a continuous ring right round it. The defective coil may easily be localized, as the bars will be burned and blackened. The machine may be temporarily repaired by joining together the two bars. A grounded commutator or armature coil on a machine with one pole earthed, in the case of a motor, will usually blow the fuses; in the case of a generator, the coils short-circuited will probably be burnt out. Often considerable damage is done through the mica not wearing evenly with the copper; the mica should preferably be reduced by stoning, and then grooved out to a V shape. In large machines, never rely on testing with a magneto, since the static capacity is generally sufficiently large to ring the bell; an ordinary Wheatstone bridge or voltmeter should be used.

Lightning Effects in Germany.

According to Herr O. Steffens, says the "Electrician," London, who read a paper on this subject before the Elektrotechnischer Verein in Berlin, the number of lightning discharges in Germany causing damage has increased in the last 50 years very much quicker than the number of insured houses. If the annual number of injurious discharges per one million houses be taken as a basis, it is found that for Oldenburg, Schleswig-Holstein, Mecklenburg, Pommerania and East and West Prussia, the number is at present about 350. In the more southern parts of Germany—viz., in Bavaria, Wurttemberg, Baden and Hessen, the corresponding figure is only 150. The curve representing the lightning discharges with the time takes the form of a well-defined wave slanting upwards, the maxima occurring every 5½ years. If a curve representing the relative values of sun spots be plotted above the lightning curve, it is observed that the maxima of the sun spots occur regularly every 11 years—i. e., one complete cycle of the sun spot curve corresponds to exactly two cyles of the lightning curve. The maximum of sun spots always coincides with a minimum of danger from lightning. In the Rhine Province the number of injurious lightning discharges per one million houses has increased some 559 per cent. during the last 40 years, Next in order comes the Kingdom of Saxony and then the Province of Saxony. It appears that the danger of a house being struck by lightning is from two or three times greater in the country than in towns. An increase in lightning phenomena has also been observed in Hungary, North America and Denmark.

Electricity at the Wilkes-Barre Mines.

The use of electricity in mining has become more and more necessary to its successful operation. In fact, reports and statistics prove that the operation of mining machinery is most effectively conducted by its means. The mines at Wilkes-Barre, Pa., are a typical example of this idea. A contract has been placed, which will lead to the complete rehabilitation of the equipment there. The drills, hoisting machinery and tramways will be run by motors. The ventilation will be done by means of electric pressure and exhaust fans, and finally the lighting will be carried on by arcs and incandescents throughout the larger and smaller galleries of the mines.

Conclusions in this case have been reached only after a long series of experiences. As they are among the largest and best known mines in the world, this change may herald a transformation in mining methods all over the civilized world.

The Use of Electricity in Egypt.

The German Consul at Alexandria, in a recent report to his Government, states that the question has again been raised as to whether electricity could not be employed for motive power in Egypt. The irrigation works would constitute the most important demand. Irrigation is now carried on by means of small machines, which are spread over the whole of the district, and only irrigate comparatively small tracts. It would, therefore, be profitable to set up large power stations with modern plant. These could distribute the electricity to motor-driven pumps erected by the land-owners at the places necessary. It has been recognized that this system would be much more advantageous than the present one. A French engineer attached to the Lands Department has arranged for the utilization of electrical plant for the driver of pumps, which has formerly only been used during part of the year for ginning and pressing cotton, and the rest of the year has remained idle. A large German landowner has arranged with the firm of Siemens-Schuckert for the utilization of electric power on his estate near the Barrage.

In Upper Egypt there is the greatest opportunity for the use of electricity for motive power, owing to the situation of the Nile cataracts. With the exception of the tramways of Cairo and Alexandria, electricity is only used in Egyptian towns in a very unimportant degree for power supply. The use of electricity is limited, owing to the large cost of production, due to the high price of coal; petroleum is cheap, and the petroleum motor is therefore much more economical than the elecric motor. On the other hand, considerations of cleanliness have led to the use of electricity. Nobody has as yet introduced electric lifts for use in the large lodging houses, where the rooms are very high owing to the heat, and the staircases consequently, very tiring. The upper rooms are more desirable owing to the purer air, but are discounted because of the lack of lifts. There is also a good opening for electric ventilators in Egypt. Competition has greatly reduced the price, and 30 cm. ventilators can now be obtained for 65 francs, 40 cm. ventilators costing 85 francs. The mistake is often made in supplying goods for the Egyptian market, of considering cheapness only, without care as to the article delivered. It is necessary that the goods should be well made and reliable without being extremely well finished.

Boston's Electrical Exhibition and the National Electrical Contractors' Convention.

A large crowd has been in attendance at the Electrical Exhibition in Boston, which opened at the Mechanics' Building Saturday evening, and will continue until July 22. In addition to the large number of exhibits of electrical appliances at the exhibition there are a number of special features showing the spectacular side of electrical development.

To-day (Wednesday) the fifth annual convention of the National Electrical Contractors' Association will begin in the Mechanics' Hall Building and the sessions will continue on Thursday and Friday.

A feature of the convention to-day will be the open session. At 10 o'clock the address of welcome to the members and guests will be made by F. L. Barnes, president of the Massachusetts Electrical Contractor's Association. The address of welcome on behalf of the State will be made by Governor W. S. Douglass. The address of welcome to the city will be made by Mayor P. A. Collins.

Mr. Ernest McCleary, president of the National Electrical Contractor's Association, will respond.

Mr. Charles L. Eidlitz, of New York City, will deliver an address entitled "The Electrial Contractor." The following addresses will also be made: "The Jobber and the Manufacturer," A. L. Gorham, general manager of the Manhattan Electrical Supply Company, New York City; "The Underwriter," F. E. Cabot, of Boston; "The Relations of Inspector and Contractor," by J. P. Kennedy, commissioner of wires, of Boston.

An executive session of the association will be held on Wednesday afternoon, and at 6 P. M. the annual dinner will be given to the members of the association.

Thursday morning will be given up to a business session. On Thursday afternoon there will be a sail down the harbor to Paragon Park. Free passes will be given to all shows.

Friday morning and afternoon will be devoted to business sessions, and arrangements have been made for the session continuing on Saturday if the convention has not already adjourned.

A ladies' committee of 30 has been appointed to have charge of the entertainment of the lady guests of the association. Concord, Lexington, Bunker Hill, Harvard College and other historic and interesting places will be visited and an extended auto trip will be taken along the picturesque North Shore. Side trips for sight-seeing and shopping will be made daily. Delegates have already been reported from 39 States.

Big Fans for the Subway.

It was announced Saturday that it has been decided by the New York Rapid Transit Commission to equip the Subway stations at once with powerful rotary fans to draw the heated air out of the tunnel. The fans are to have a capacity of 25,000 cubic feet per minute and to be 7 feet in height and 9 feet in diameter.

Electrically-Operated Watertight Power Doors.

Among the few American inventions which are on display at the Naval, Shipping and Fisheries Exhibition at Earl's Court, London, this summer, a full size working exhibit of the Long Arm System of electrically operated watertight power doors has attracted great attention from the large number of naval experts who have visited the display. This system, from a central station located at a convenient point on the bridge of the ship, closes the doors and hatches of the vessel in time of emergency, providing for the local safety of men involved by a liberty action attached to each door. The device has now been installed on some thirty American men-of-war, and the Admiralty Departments of numerous foreign governments are interesting themselves in the System with a view to placing it on all their own ships. In addition to the exhibit at Earl's Court, there is another full size working exhibit on display at 39 Victoria street, London.

New Hydro-Electric Equipment.

The Abner Doble Company, engineers, of San Francisco, have recently secured the contract for the machinery to be installed in an addition to the hydro-electric plant of the Cramer Electric Company, successor to the Idaho Electric Supply Company at Hailey, Idaho. This contract covers the entire water power and electrical apparatus and includes a 400 kw. alternator directly driven by an 800 hp. set of water wheels, exciter and governor; three-panel marble switchboard; two 25-light arc transformers and 50 arc lamps with regulators, switchboards and other accessories; 14 transformers and other supplies for the distribution system.

PERSONAL MENTION.

President Charles L. Edgar, of the Edison Electric Illuminating Company of Boston, left this morning for a three months' vacation in Europe.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 11, 1905

Electric Railways and Appliances.

794,194-195-196. Electric Circuits for Railway Signaling. Henry W. Spang, New York City, assignor, by mesne assignments, to Charles H. Ketcham, Yonkers, N. Y. Last application filed Oct. 3, 1903.

794,266. Electric Signaling and Electropneumatic Train-Control System. John A. Whyte, Toronto, Canada, Filed March 5, 1904.

794,269. Automatic Electric Railway-Switch. Walton D. Woolley, Normandy, Me. Filed Aug. 3, 1904.

Electric Lights and Appliances.

794,296. Electric Display-Lamp. Henry J. Gille, St. Paul, Minn. Filed Jan. 5, 1903.

794,309. Insulating-Block for Electric-Light Canopies. Isaac J. Parker, Boston, Mass. Filed Nov. 8, 1904.

794,458. Incandescent-Electric-Lamp Socket. Louis O. Gollatz, Providence, R. I., assignor to the Providence Gas Burner Company. Filed Dec. 14, 1904.

794,565. Electric-Arc Lamp. Marion A. Stogsdill, Indianapolis, Ind., assignor to the Pyle Electric Headlight Company, same place. Filed Oct. 26, 1904.

Electrical Machinery and Apparatus.

794,210. Dynamo-Electric Machine. Dimitry Balachowsky, Paris, and Philippe Caire, Levallois, France. Filed Nov. 21, 1902.

794,218. Electric Switch. Willard E. Dow, Braintree, Mass. Filed Jan. 9, 1905.

794,220. Electric-Circuit Closer. Monroe Guett, Hartford, Conn., assignor to the Hart & Hegeman Manufacturing Company. Filed Nov. 4, 1903.

794,358. Electrical Controller. Ray P. Jackson, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed June 6, 1904.

794,362-363. Electric Motor and Controlling Means Therefor. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed May 3, 1904, and Jan. 3, 1905

794,365. Voltage-Regulator. Paul M. Lincoln, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed June 30, 1904.

794,398. Electric Drill-Motor. Francis E. Drake, St. Louis, Mo. Filed Sept. 30, 1904.

794,435. Thermal Cut-out. Theodore Varney, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed June 24, 1904.

Telephones and Telephone Apparatus

794,343. Telephone-Switchboard. Martin C. Burt, Chicago, Ill., assignor to F. A. Meidinger, same place. Filed Jan. 28, 1904.

794,348-349-702. Telephone System. William W. Dean, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company, same place. Last application filed Sept. 14, 1903.

794,370. Telephone Lock-Out Mechanism. Thurston Matheny and Ruben C. M. Hastings, Athens, O. Filed July 22, 1904.

794,645. Insulator-Bracket for Telephone-Poles, etc. Knudt G. Springen, Zumbrota, Minn. Filed March 10, 1905.

Miscellaneous.

794,161. Medical-Battery Electrode. Kittie L. Van Guylder Curry, Chicago, Ill. Filed April 26, 1905.

794,208. Electrothermal-Bath Apparatus. Frank W. Weeks, San Antonio, Tex., assignor, by mesne assignments, to the Weeks Electrical Company. Filed Feb. 24, 1903.

794,240. Electric Storage Battery. August Meister and Alois Junker, New York City. Filed Nov. 11, 1901.

794,242. Tape-Controlled Telegraphic Transmitting Apparatus. Donald Murray, London, Eng. Filed Jan 5, 1905.

794,245. Electric Apparatus for Producing Sound-Signals. Charles H. O'Brien, Augusta, Me., assignor to the O'Brien Electrophone Company, same place. Filed July 18, 1904.

794,255. Electric Furnace. Cecil L. Saunders, Cleveland, O. Filed Feb. 15, 1901. Renewed Nov. 18, 1903.

794,334. Wireless Telegraphy and Transmission Across Space. Alessandro Artom, Turin, Italy. Filed May 3, 1904.

794,459. Wireless Telegraphy. William S. Hogg, Washington, D. C. Filed May 6, 1905.

794,497. Thermostat. John D. Gould, New York City. Filed Oct. 8, 1904.

794,501. Storage-Battery Grid. Michael Heisser, Chicago, Ill. Filed July 5, 1904.

794,580. Automatic Electric-Heat Control. James I. Ayer, Cambridge, Mass., assignor to the Simplex Electric Heating Company, Boston, Mass. Filed Feb. 6, 1905.

794,647. Electrostatic Magnetic Separator. Henry M. Sutton, Walter L. Steele and Edwin G. Steele, Dallas, Tex. Filed Feb. 3, 1902.

THE TELEPHONE WORLD.

Activity in Independent Interests in New York State.

The market activity in the stock of the Consolidated Telephone Company of Buffalo, lately, is an indication that there is lively interest in Independent telephone circles. The stock of this company has advanced nine points in 10 days, and it is said that thousands of shares have been bought and sold. The reason for this activity is found in the fact, as learned from reliable sources, that the Consolidated Telephone Company, which controls the Frontier Telephone Company and the Interocean Long Distance Company, is to be the nucleus of a gigantic Independent telephone corporation, which is to control all the Independent telephones in the State. The Interocean Company now covers two-thirds of the State with its toll lines, and has over 75,000 'phones connected with those lines. It connects with nearly all Independent exchanges in the State, and the advantage of a general consolidation of all these companies is so manifest that the movement is meeting with no opposition.

Reports show there are over 150,000 Independent telephones in New York State, with nearly 500 separate companies. The Consolidated now owns many of these exchanges, and is now planning to secure the others. Recently the large telephone interests in Rochester were optioned at nearly double their cost for apparently this same purpose, and many of the smaller plants are rapidly going into the hands of the larger companies. It is intimated that the Gould interests, which control the Western Union Telegraph Company, are inclined to give the Independent an entrance to that city, on account of the great lawsuit pending between the Western Union and the Bell. If some such arrangement is not made, an Independent system will probably be established there.

Whatever is done in this direction, it looks as though the Consolidated Company would be the chief facter in bringing all the Independent interests of the State together, for the reason that it controls practically all the long distance lines in this State and to points in adjoining States.

Pocket 'Phones for Conductors.

All the conductors of the country lines of the Westchester, Pa., Street Railway Company have been equipped with telephones of a unique design, which they carry in their pockets. In case of need these 'phones can be used at points a short distance apart on the line, where connections are supplied.

A farmers' telephone line is in course of construction between Clayton and Palm, Pa. The projectors are Henry H. Schultz, Alfred G. Clemmer, Josephus Gerhard, James B. Funk and Dr. Gery, of Palm. The line will give accommodations to about 25 farmers and business men along the route.

The 1st of August the Winnebago County, Ill., Telephone Company will have four new ines in operation and in September it expects o have New Milford connected with Rockford, and also an exchange in the latter place, havng no less than 60 subscribers. D. W. Baringham is general manager of the company.

Independent Company's Difficulty in Line Construction.

The Morgan County Telephone Company, an Independent Company of Decatur, Ala., which owns lines in other Southern cities, is building a long distance line from Decatur to Mobile via Birmingham and Montgomery. It has practically been completed from the former city to Cullman, 33 miles.

Charges are made that the American Telephone & Telegraph Company has been sending agents ahead of the Independent people, buying franchises, and that in more than one instance the Independent company has been compelled to go several miles out of the way in order to get around these franchises.

The Independent company is also building a line to Memphis, Tenn.

Report of Michigan State Telephone Company.

N. W. Harris, chairman of the board of directors of the Michigan State Telephone Company, has just issued to the stockholders the first annual report. The company succeeds the Michigan Telephone Company. Since the present management took possession in February, 1904, the number of telephones has been increased from 48,778 to 70,832. The earnings of the company have also been largely increased. It has been the policy of the present management to use its net surplus for additions and betterments to the company's property, $579,955.03 having been used for maintenance expenses alone for the year ending April 30, 1905.

The articles of incorporation of the Woodworth Telephone & Telegraph Company, of Union Springs, N. Y., were lately filed. The company proposes to build and operate telephone lines in the towns of Aurelius, Springport and Ledyard. The articles state that the capital stock of the company is $15,000, composed of 600 shares at $25 each. The duration of the company is 50 years and $10,000 of the stock has been paid in. The stockholders are Henrietta Woodworth, Oscar J. Spencer, Arthur M. Seekell, Louise M. Seekell, Charles M. Hart, Michael McGrath and LaVerne Doremus, all of Union Springs.

A new metallic circuit connecting Spokane with Tacoma, Wash., is the improvement in telephone service promised the last of this month. This line goes by the way of Clealum, and there will be no stations on the line, so that direct communication will be furnished.

The Wingo Telephone Company of Graves County, Ky., is a new concern having a capital stock of $1,500.

The Walworth, Wis., Telephone Exchange Company has increased its capital from $2,200 to $4,200.

Liberty Hill, Conn., is to be provided with telephone service. The poles are nearly all up and the wire stringing will be quick work.

The Peoples' Telephone Company, of Jacobsburg, O., recently increased its capital stock from $2,000 to $4,000.

Many Additions to Telephone Plant.

Several of the large additions and improvements which the Home Telephone Company of Utica, N. Y., has had under way for some time are nearing completion and will add to the efficiency of the system in connections with out-of-town places.

The new exchange in Newport, which was opened about a month ago, now has over 100 subscribers. Additional 'phones are being placed each week, and it is expected that the number of subscribers will be greatly increased during the next few weeks. A long distance line is now being constructed with a metallic circuit, connecting direct with the lines of the Black River Telephone Company, and direct with Utica. The new line will afford advantages now impossible on the present circuit and will make the towns and cities connected easy of quick access.

The improvements in the Clinton circuit are among the foremost in the company's plan of advancement. The new telephone building at Clinton is ready for occupancy. The new switchboard has been installed and the system connected with the underground cables which have been laid. The Clinton exchange now has over 350 subscribers.

The sytem in Utica is being improved by the addition of about 10,000 feet of cable which is being laid on several streets. The new cables will bring into the office of the plant about 900 more lines.

Other improvements which are being planned will be commenced soon. The company is rapidly placing its system in a most complete manner, as its service indicates.

The Polk County Telephone Company, formerly the Golden Rod, has lately held its annual meeting of the stockholders in Osceola, Neb., and admitted a new stockholder, M. F. Smith, by selling him a one-fifth interest in the company, so that there are five stockholders, O. E. Mickey, A. F. Nuquist, H. D. Skelton, E. R. Stanton and M. F. Smith, three from Stromsburg and two from Osceola.

A $20,000 switchboard has been purchased by Col. E. H. Beggs, of the Independent Telephone Company, of Boise, Ida. It is one of the latest designed central energy double lamp supervisory multiple switchboards and will have a capacity of 6,000 lines for 24,000 subscribers. The board will be installed in the new headquarters about September 1.

With a capitalization of $25,000, the Wehn Telephone Company, of Bridgeport, Neb., has been incorporated.

The Driftwood, Pa., Telephone Company, capitalized at $10,000, has lately been formed.

The Telegraph & Telephone Company, of Towanda, Pa., is capitalized at $10,000.

Telephone Incorporations.

The Polo Mutual Telephone Company, Polo, Ill. Capital stock, $5,000, Incorporators: John Eckerd, C. W. Hays and C. C. Price.

The Hiram Telephone Company, of Portage County, Hiram, O. Capital stock, $10,000. Incorporators: H. C. Hurd, W. M. Dudley, E. E. Snoddy, H. F. House and G. A. Vincent.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Burlington, Kan.—A deal was lately completed by which the electric light plant of this city was transferred to a new firm. The purchasers are G. H. Webb, of Halstead, and G. Woebe, of Junction City.

Cicero, Ind.—John Plan has completed arrangements to put in an electric light plant here.

Clatskanie, Ore.—The Shakes Transportation Company, of Portland, is negotiating with the Clatskanie city council for the erection of an electric light plant, and the council will probably vote favorably at its next meeting.

Covington, Ky.—A proposition of the Union Light, Heat & Power Company to light the streets of this city with electric lamps for one year, with the privilege of renewing the contract, was lately accepted by the council.

Elmwood, Ill.—E. L. Brown, of the Elmwood ElectricLight Company, will ask for a franchise from the village of Brimfield to extend his wires to light that city.

Frederick, Md.—The Frederick Electric Light Company is arranging with the board of commissioners of Middletown to light that town with electricity. Middletown is eight miles west of here on the National pike, and current will be transmitted from this city.

Fredericksburg, Va.—The Rappahannock Electric Light & Power Company has been incorporated with a capital of $10,000. The officers are: J. B. Ficklen, president; A. D. Tapscott, secretary. The object of the company is to erect and establish an electric light and power plant.

Greenup, Ky.—Col. E. E. Fullerton and Hubert Willis, of this place, have announced their intention of putting in an electric light system at Russell.

Jefferson, Tex. —The Jefferson Light & Power Plant, including a new electric light and ice plant, was recently burned. The estimated value, $17,000 to $18,000; insurance $15,000.

Lee's Summit, Mo.—H. C. Thomas, of this place, has been named as the temporary receiver of the Electric Light Plant Company here by Judge Park, of the circuit court.

Lewisburg, Pa.—The Lewisburg gas and electric light plant was recently purchased by Philadelphia capitalists.

Memphis, Tenn.—Commissioner John T. Walsh has prepared a resolution directing compliance by the city with the act of the last legislature which requires the construction of an electric lighting plant. The resolution will be presented to the council at the first meeting at which the call leaves an opening for its consideration.

Morelia, Mex.—A company has been organized here to acquire the electric lighting plant of this city, which is now operated by steam power, and to establish a water power plant of 2,500 hp. to operate the system and also to furnish power in other industrial enterprises. The power will be derived from the San Pedrito waterfall in the vicinity of this city.

Norwalk, O.—The Bell Island Improvement Association has voted to have electric lights on the island, to repair the walks, and to do other things for the general betterment of the summer resort. New officers were chosen as follows: President, Jesse M. Ferris; vice-president, Richard H. Golden; secretary, James H. Seeley; treasurer, Dr. J. J. Strohmeyer.

Paul Smith's, N. Y.—The Paul Smith's Electric Light & Power Company, capitalized at $100,000, has been organized with the following directors: Paul Smith, Sr., Phelps Smith and Paul Smith, Jr.

Portland, Mich.—The electric light plant here will be enlarged and improved next month.

Richmond, Va.—At the recent meeting of the water committee, that body unanimously adopted the report of the sub-committee, indorsing the proposed new electric light plant to be erected on the site which is now occupied by the old pump house.

Rural Retreat, Va.—W. C. Lawson contemplates installing an electric light plant at the Rural Retreat Mills, and will probably furnish light and power for this town.

Spring City, Pa.—It is said that plans for the new electric light plant are rapidly being perfected. Well-known local capitalists are at the head of the proposed company.

Villa Grove, Ill.—It is believed that this village will soon be lighted with electricity. The board of trustees is making investigations with a view to passing an ordinance providing for such service.

STREET RAILWAYS.

Austin, Tex.—The charter of the Gainesville, Whitesboro & Sherman Electric Railway Company was lately filed with a capital stock of $500,000. The incorporators are G. A. Hassinger and H. L. Lazarus.

Brazil, Ind.—Indianapolis and Eastern capitalists have filed with the Secretary of State for the incorporation of a company to be known as the Indianapolis & Ohio Valley Traction Company, with a capital of $250,000. Joseph H. Larimee, of Indianaplis, has been elected president, and David H. Morgan, of this city, secretary of the corporation. It is the purpose of this company to build a traction line of over 300 miles.

Clifton Heights, Pa.—After a spirited session the borough council lately granted the Philadelphia & Garrettford Street Railway Company the right to construct and operate a trolley line in this borough.

Creston, Ia.—The building of the Oskaloosa-Buxton Interurban Trolley Road now seems almost assured. A company has been organized with a capital of $500,000 for the purpose of constructing the road.

Dayton, Wash.—The project of an electric railway in Columbia County appears to be growing in public favor. Many farmers, some of them the wealthiest in the county, have expressed themselves as willing to encourage such an enterprise by liberal contributions.

Dodd City, Ark.—The Mineral Belt Traction Company, of Chicago, has been formed to build a line between this city, Kingdon Springs and Lead Hill. Its capital stock is $200,000. The incorporators are A. J. Bradford and Robert Somerville.

Gulfport, Miss.—Work has been commenced on an electric railway that will connect Biloxi and Pass Christian, and eventually link Mobile and New Orleans. The company that is building this line in capitalized at $1,000,000, with Captain Joseph T. Jones the president. The power house will be located here and will cost $200,000.

Janesville, Wis.—Surveyors have begun the work of laying the route of a proposed electric railway line from here to Waupaca. The capital is to be furnished by Philadelphia parties.

Lynn, Mass.—The Nahant & Lynn Street Railway Company has been authorized by the Railroad Commission to capitalize the cost of building and equipping its electric railway at $50,000.

Milton, Ore.—That this city will soon have electric car service to Walla Walla, Wash., is now an assured fact. Mr. Anderson, who has the road in charge, has stated that the line is to be built at once, and that $35,000 is now on hand to begin the work.

Nevada City, Cal.—Work on the electric road from here to Marysville will soon be under way, and before many months the road will be in operation.

Oberlin, O.—The Oberlin & Lorain Railway Company proposes to build an electric road between this city and Lorain, running by the way of North and South Amherst. William S. Donaldson and G. F. Herrick, of Lorain, are the directors.

Oran, Mo.—The Oran Electric Railway Company has been incorporated with a capital stock of $50,000. M. G. Gresham and George Metz are the incorporators.

Richmond, Va.—The Grasberger Trolley Company was lately incorporated with a capital of $10,000. The officers are: Hiram T. Gates, president; Boniface A. Grasberger, secretary and treasurer

Somerset, Va.—A deal will soon be closed between Dr. W. Godfrey Hunter and others, O. H. Waddle and the Somerset Company for an electric railroad franchise.

Sutton, W. Va.—The Elk River Railway & Electric Power Company of this city has been incorporated to build an electric railway about five miles long from Gassaway to this city. The incorporators are George H. Borlean, of Pittsburg; W. H. Cochrane, of Dawson. Pa.; J. T. Berry, of Hesters, W. Va.; L. W. Martin and John B. Morrison, of Sutton.

POWER PLANTS.

Danville, Ill.—Plans are being matured in this city by H. C. Hoaglund, of the Illinois Traction Company, for a new power plant at Bloomington, or the remodeling or enlarging of the present plant.

Oroville, Cal.—The Oroville Light & Power Company is preparing to put in a large power plant on West Branch.

St. Johnsbury, Vt.—An important business deal has been consummated, by which the St. Johnsbury Electric Company has acquired of E. T. and H. K. Ide, of this city, the water power at Passumpsic. The company will erect at once a modern station to supply more power and lights for St. Johnsbury.

York, Pa.—Deeds giving possession to severa thousand acres of land in York and Lancaster Counties, along the shores of the Susquehanna River, to Cary T. Hutchinson, a New York capitalist, were placed on record this month. They represent another large number of real estate transactions closed by the promoters of the project to build large hydro-electric power plants along the Susquehanna.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15@15⅛c.; Lake 15@15⅛c.; casting, 14⅝@14⅞c.

Earnings of the Philadelphia Rapid Transit Company are said to be running $14,000 a day ahead of last year.

On June 30, which closed the fiscal year, the Boston Edison Company had a floating debt of $825,000, against $1,083,000 on June 30, 1904.

Arrangements have been completed for the transfer of the municipal lighting plant at Elgin, Ill., to the Traction Company of that city.

Gross earnings of the Metropolitan Street Railway system of New York for June were $1,887,834, the largest for any June in its history.

Justice Gildersleeve of the Supreme Court, New York, has filed a modified order giving the New York Board of Estimate and Apportionment full power to approve plans and consent to construction of new rapid transit routes.

A special meeting of the shareholders of the Massachusetts Electric Companies is called for July 28 at noon in Boston for the purpose of authorizing the refunding of $2,700,000 5 per cent. coupon notes which mature January 1, 1906.

Stockholders of the Philadelphia & Garrettford Street Passenger Railway Company on Saturday authorized an issue of $3,000,000 fifty-year 5 per cent. general mortgage bonds. The stock of this company is owned by the Philadelphia & Westchester Traction Company.

John I. Beggs has been unanimously elected trustee for the creditors of the National Electric Company of Milwaukee, Wis. Statements made by attorneys were that the business of the company had been conducted at a profit during the receivership. The bond was fixed at $500,000.

A director of the Chicago Edison Company says the earnings of the company are well in excess of all previous exhibits in the history of the concern. There has been more work done and a larger number of new subscribers for current added during the last six months than ever before during a similar period.

The Frank Jones Electric Light & Power Company's plant at Portsmouth, N. H., has been sold to the Rockingham County Electric Light & Power Company. The Jones plant has been taken by the reorganizing committee of the New Hampshire Traction Company, of which the Rockingham County Company is a part.

The statement is made, but not officially, that earnings of the Allis-Chalmers Company are large and that a sufficient surplus is being accumulated over and above money now being expended for extensive improvements to pay a dividend at the regular rate of 7 per cent. on the preferred stock. It is said to be simply a question of policy when payments should be begun.

N. W. Harris & Co., New York, are offering to investors $1,200,000 Omaha Electric Light & Power Company first mortgage 5 per cent. bonds, due July 1, 1933, but optional at 105 and interest on and after July 1, 1908. This company owns or controls practically the entire electric light and power business in Omaha, South Omaha and Council Bluffs, the combined population of the cities being at present more than 170,000. The company and its predecessor have paid annual dividends of 5 per cent on the preferred stock for the past fifteen years.

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price July 17
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	202¾
Manhattan Elevated Railway	165½
Metropolitan Street Railway	126⅜
Metropolitan Securities	82¼
Ninth Avenue	197
Third Avenue	126¼
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	69⅜
Brooklyn City Railway	239
New Orleans Railway	34¼
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	83¼
Philadelphia Traction	100
Union Traction	59¾
Boston.	
Boston Elevated	157
Massachusetts Electric Companies, com	18¼
do. do: do. pref.	63¾
West End Street, com	97½
do. do. do. pref.	114¼
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	7½
do. do. pref.	31
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	16¼
do. pref.	58½
Electric Boat, com	28
do. do. pref.	65
Electric Lead Reduction	
Electric Vehicle, com	18
do. do. pref.	27
Westinghouse, com	167¼
do. pref.	194
General Electric	175
Boston.	
Edison Electric Illuminating	245
General Electric	175
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	160
National Carbon, com	63
do. do. pref.	118
Philadelphia.	
Electric Company of America	11⅜
Electric Storage Battery, com	82
do. do. do. pref.	82
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	139¼
Western Telephone Company	18
New England Telephone Company	138¼
New York.	
American Telegraph & Cable Company	90¼
Commercial Cable Company	210¼
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	172¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93¼
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Otis Elevator Company	60
Consolidated Car Heating	64
Standard Underground Cable	

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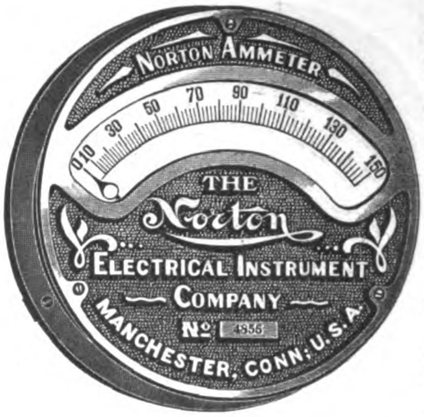
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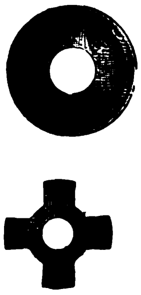

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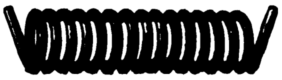

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EDITORIAL NOTES.

Electric Lamps and Light Mixtures.

The difficulty in obtaining good light does not depend upon the pressure or the regulation of the generator as is commonly supposed. The value of an illuminant is entirely dependent upon the light mixture it affords. This is hardly a subject which can be classed as purely practical from either the artisans or manufacturers' point of view, yet a little reflection will serve to show how utterly futile are the attempts of lamp makers, whether electric or otherwise, to produce good light unless they follow the road pointed out in the laboratory. This bit of practical science is simple enough to understand with reference to sunlight as a standard.

The prevalent idea is to emulate this example as far as possible, to produce, if the effort is not beyond our scope, artificial daylight. But then the question naturally arises "what is artificial daylight?" In what respect does it differ from the light of a candle, oil lamp, Welsbach burner or incandescent lamp, etc.? An analysis of artificial daylight discloses the fact, well known to every reader of an elementary physics, that white light is composite. The violet, indigo blue, green, yellow, orange and red of the traditional spectrum are fused or mixed together in ordinary daylight.

Experiments have shown that an excess of yellow or red, of blue or green, or, in fact, theoretically of any other color in the light of a lamp or source of illumination is a defect. It is not a quantity of light that is wanted as much as a quality of light. This is by far the most important point as far as our æsthetic sense is concerned. It is not pleasant to see by a light which destroys the customary relationships of color. The absence of one element from the light mixture may be the cause of this phenomenon. The presence of a superabundance of a certain class of waves may be equally capable of producing unusual effects.

The Welsbach mantle, for instance, is notoriously deficient in red rays, producing the appearance of pallor and a greenish tinge on healthy countenances. Quantity of light is, of course, a desideratum of the first order, but it will not be a popular form, however cheap, unless accompanied by the proper color. Arc lamps are frequently affected by an excess of violet rays quite noticeable in many public places. The voltage and carbon are the cause in this case and should receive attention.

Incandescent lamps, as well as arcs, produce rays which radiate wastefully. On this account, a general redesign has been gradually accomplished, which yields in both instances phenomenally good results as compared with the crude and inefficient lamps of the past.

* * *

Maintenance of Submarine Cables versus Wireless Telegraphic Apparatus.

The wireless field is unlimited in its scope and possibilities, and the reason for this belief looms up larger and larger with each new success in its inevitable development toward perfection. The financial management of a cable system would not hesitate to acknowledge the existence of an expense account for maintenance that is regarded as one of the unfortunate concomitants of the business. They could, if requested, produce interesting little items for repairs, representing, for instance, the sum of $375,000 in connection with one break on which a 116-day effort was spent in patching it up. They might turn back the pages of the ledger and show that the cost of maintaining a repair ship, with its staff of experts and accessories, runs up to $1,500 a day. But to be just, it is necessary to state that these figures, though honestly recorded, are not established year in and year out. It has been calculated that the average expense belonging entirely to the field of repairs in the case of each Atlantic cable does not fall short of $40,000 a year. The interest on the original investment, in addition to this sum, shows clearly an enormous annual expense, before a dollar can be made for the stockholders.

Let us glance at the situation with regard to wireless telegraphy. Here is an opportunity for striking out entirely from the expense account the element of repairs as it appears above. Not only is this element entirely removed but in certain respects a greater certainty in transmission is obtained, despite the apparent intangibleness of the operation. The old idea that energy must pass through the channel or wire we provide is about to be relegated to the scrap heap of ultra-conservatism. Nature herself is employing the wireless method in all operations. The physicist will frankly admit the absence of any means of communication between molecule and molecule, or mass and mass, except that supplied by the universal plasm—the ether itself. For this reason there is no elusive theory to be followed out by the wireless telegraph expert. His task has become one of the engineering propositions of the present. It is so definite to-day, that the dollars and cents end of it can be estimated with accuracy. The cable and wireless are established as far as we can see. The next point to consider, after all is said and done, is the degree to which the general public will receive benefits. How much less will transatlantic messages cost when competition sets in than at present? When will these methods of communication prove legitimately attractive to the man that works by the sweat of his brow?

* * *

Is the United States Developing an Export Trade in Automobiles?

With automobiles of French-make, costing from $15,000 to $30,000, it is interesting to inquire into our own automobile industry. We take pride in our mechanism and methods; in our deftness and cheapness of production. Where are we at in the international competition in automoble construction?

America is destined to forge ahead in all her mechanical and electrical enterprises. She is now developing an export trade in automobiles. In 1903, ending with May, we exported $1,038,792 worth of autos; in 1904, $1,713,807 worth, and in 1905, $2,167,744 worth of these vehicles. Statistics are regarded by some as delusions, but it is necessarily scientific to admit their veracity if properly founded. The question abroad is always quality and price. It is, of course, the same here. But the German, Frenchman or Englishman will think twice before he spends more money on a machine of home manufacture of only equal quality to that of American-make. If exports in 1903 are nearly doubled by those of 1905, it is reasonable to presume that the United States is living up to its reputation as a nation of fine mechanics. European makers may soon find they are carrying coals to Newcastle, if American ability has not been over-rated in similar instances.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Dr. Gisbert Kapp has accepted a professorship in electrical engineering at the University of Birmingham, Eng., and has resigned as general secretary of the German Association of Electrical Engineers and as editor of the "Elektrotechnische Zeitschrift."

◆

The city officials of Columbus, O., after a thorough investigation, covering four years, have discovered that municipal ownership of an electric lighting plant is not a paying investment.

◆

Gov. Higgins of New York has appointed Frederick E. Gunnison of Brooklyn as State Commissioner of Gas and Electricity. This fills the commission. The other members of the commission are John C. Davies of Oneida, and Lucien L. Shedden of Clinton.

◆

The new power house of the Brooklyn Rapid Transit Company at Kent and Division avenues, Brooklyn, N. Y., is rapidly approaching completion and it is the expectation that by August 1 the installation of electrical machinery will have been begun there.

◆

Work is about to begin on the new mountain railway which is to make the snowy heights of Mont Blanc accessible to the ordinary tourist. The line will start from the little village of Le Fayet, at the western end of the Chamonix valley and will ascend by a wide sweep up the northwest side of the mountain. It will terminate not at the actual summit of Mont Blanc, but on the plateau of the Aiguille du Gouter, which is 12,700 feet high. From this point the ascent to the actual summit of the mountain, which is 3,000 feet high, can be comfortably accomplished in about 4 hours. The line, which will be on the same principle as the Jungfrau electric railway, will be about 12 miles in length and it is expected to be completed in 5 years. The journey from Le Fayet to the "summit" station will take 4 hours, and a return ticket will cost $20.

◆

Mr. George Tripp, secretary, writes us that the annual convention of the Colorado Electric Light, Power & Railway Association will be held at Glenwood Springs, September 18, 19 and 20.

◆

An official trial of a submarine signaling apparatus by the German Admiralty has taken place in Kiel harbor, and proved so satisfactory that an order for the adoption of the apparatus was at once given. A bell weighing 140 lbs. was suspended at a depth of 20 feet from the Gabel Flasch lightship, and the sound was heard with such distinctness at a distance of 3½ miles that its direction could be readily located with precision. At a distance of 5½ miles the sound was heard in sufficient volume but was disturbed by other sounds in the harbor.

◆

Assistant Secretary of the Navy Darling has issued orders for the consolidation of the power plants at the navy yards at the following places: Brooklyn, Boston, Philadelphia and Norfolf. It is estimated that the merging of the plants at the Brooklyn yard will save between $10,000 and $15,000 a year.

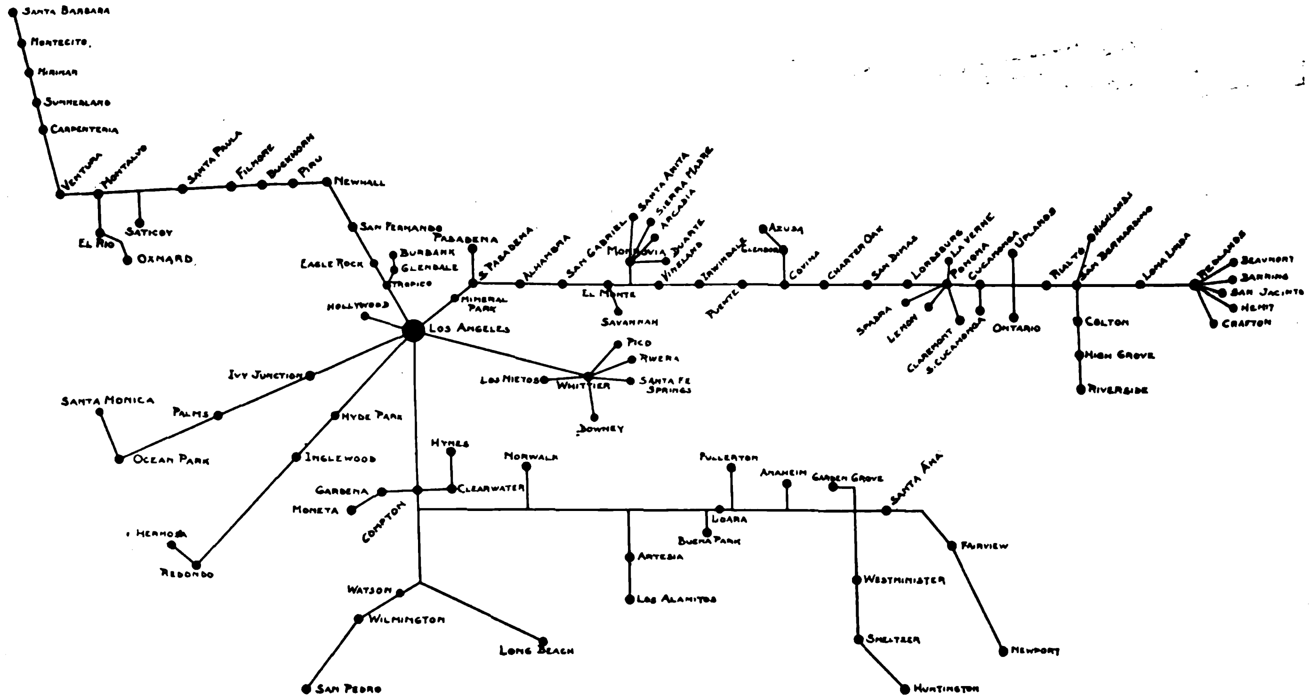
◆

Work on the plans of Mayor Dunne's 240-mile municipal street railway system in Chicago has been started. A. B. Dupont, the Detroit traction expert, will at once begin the task of mapping out the routes of the proposed system. He will prepare estimates of the earning power of the various lines of the system and the cost of operation, but will not go into the cost of construction or any of the engineering features of the plan. These will be left to Bion J. Arnold, the local transportation committee's expert. Mr. Dupont will confine his efforts to laying out the routes of a system on streets on which the franchises have expired and devising plans for connecting lines where breaks occur in the proposed municipal system. He will endeavor to assemble all the expired franchise lines into a unified system.

TELEPHONE GROWTH IN SOUTHERN CALIFORNIA.

BY P. KERR HIGGINS.

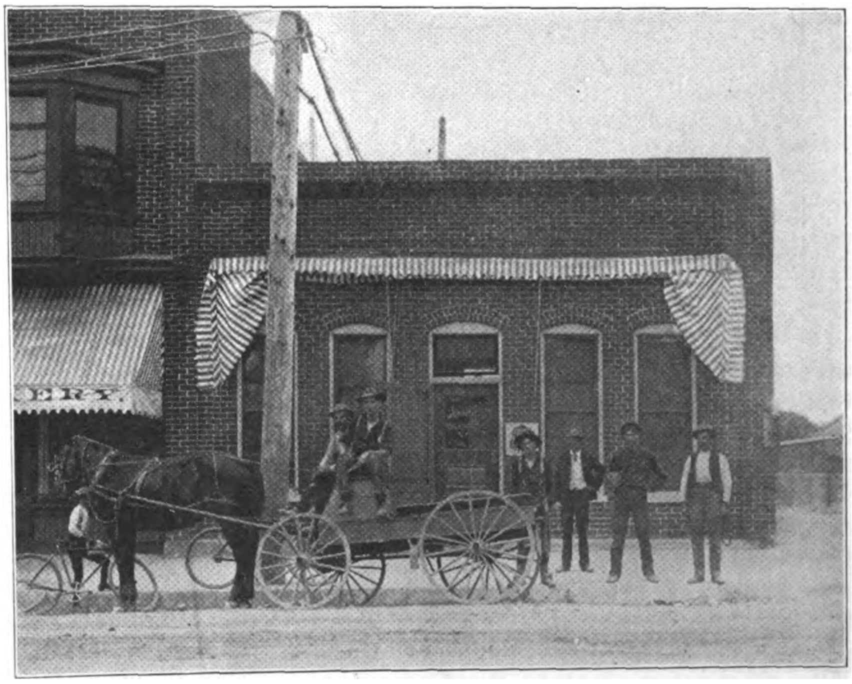
Three years ago there was only one Independent telephone exchange in all Southern California, and that a very small one. To-day there are 19 in actual operation and 10 more in course of construction at Downey, Oxnard, Redondo, Santa Paula, Alhambra, Saticoy, Anaheim, Fullerton, Ocean Park and Santa Monica. The first exchange was located at Monrovia and for a long while was the thorn in the side of the great Bell sub-licensee, the Pacific States Telephone & Telegraph Company. The town of Monrovia is very beautifully situated at the foot of the Sierra Madre Mountains and is one of the best residential towns in all California. It boasts a population of 4,000, and the exchange opened up with less than 100 subscribers; to-day it has nearly 400. This is a fair sample of the progress being made in this part of the country. The following table shows the standing of the various exchanges as of February 1, 1905, and these figures are being increased every day:


Santa Barbara
Montecito.
Miramar
Summerland
Carpenteria
Ventura
Montalvo
Santa Paula
Filmore
Buckhorn
Piru
Newhall
El Rio
Saticoy
Oxnard.
San Fernando
Eagle Rock
Burbank
Glendale
Tropico
Pasadena
S. Pasadena
Alhambra
San Gabriel
Santa Anita
Sierra Madre
Arcadia
Monrovia
Duarte
Vineland
El Monte
Savannah
Irwindale
Glendora
Azusa
Puente
Covina
Charter Oak
San Dimas
Lordsburg
La Verne
Pomona
Cucamonga
Uplands
Spadra
Lemon
Claremont
S. Cucamonga
Ontario
Rialto
Highlands
San Bernardino
Colton
High Grove
Riverside
Loma Linda
Redlands
Beaumont
Banning
San Jacinto
Hemet
Crafton
Hollywood
Mineral Park
Los Angeles
Pico
Rivera
Los Nietos
Whittier
Santa Fe Springs
Downey
Ivy Junction
Santa Monica
Palms
Ocean Park
Hyde Park
Inglewood
Hynes
Norwalk
Clearwater
Gardena
Moneta
Compton
Hermosa
Redondo
Fullerton
Anaheim
Garden Grove
Santa Ana
Loara
Buena Park
Artesia
Los Alamitos
Fairview
Westminister
Watson
Wilmington
Long Beach
Smeltzer
Newport
San Pedro
Huntington

Map of Long Distance Lines of Southern California's Pioneer Independent Telephone Exchange.

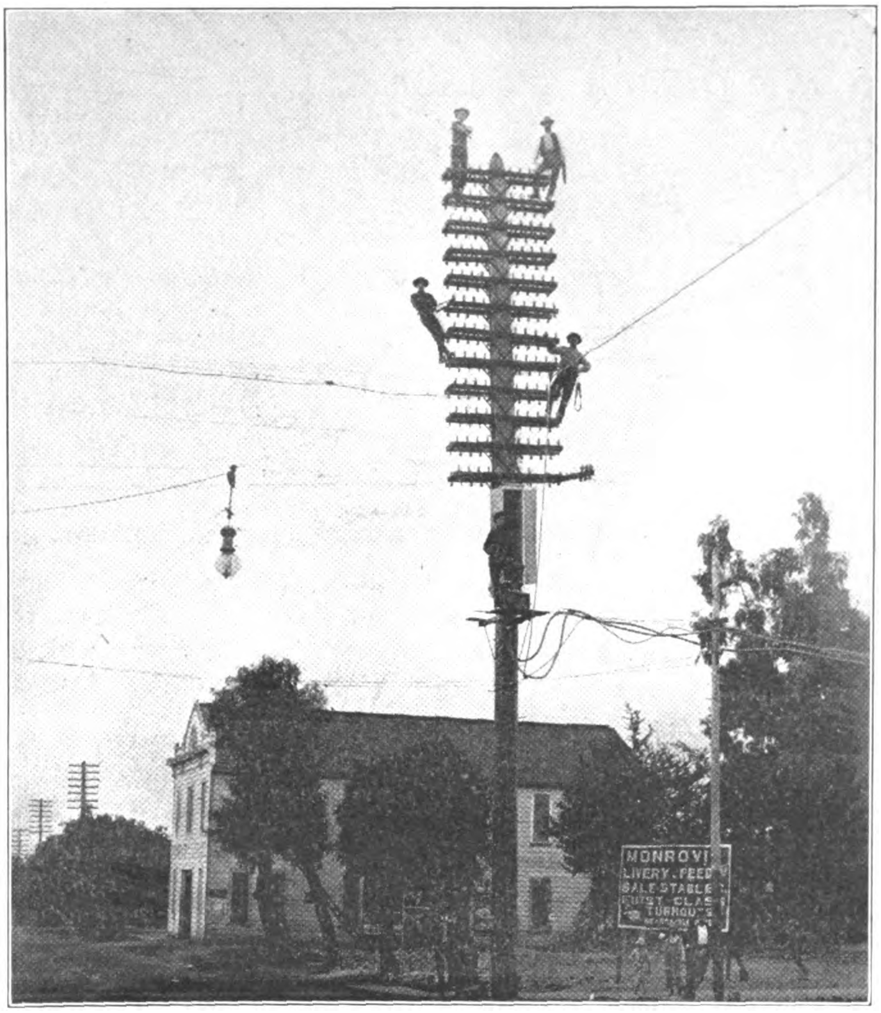
Town.	Sunset.	Home.
Santa Ana	370	400
San Bernardino	640	560
Redlands	600	710
Santa Barbara	927	991
Pomona	410	900
Covina	4	425
Whittier	140	370
Pasadena	2,250	1,580
Los Angeles	14,930	16,000
Riverside	1,684	1,250
Long Beach	200	652
San Pedro	100	120
Glendale	..	165
Hollywood	26	180
Compton	1	200
Ventura	275	160
Smeltzer	1	160
Monrovia	2	325
Fernando	3	51
San Diego	1,500	1,200

The construction work at Monrovia was done by men having had very little experience in the telepone business, but with the advent of Eastern capital and experienced men in the building of the Los Angeles plant, Monrovia saw how necessary it was to rebuild the plant and so a new company was formed, and Mr. Baldwin, an experienced man who was employed as manager, took charge about a year ago and during that time has wrought many changes, improving the service and the plant. The next exchange to open was that of Covina and a little later that of Los Angeles; the others followed rapidly and the end is not yet. The Covina exchange was erected by that energetic builder, Mr. P. T. Spencer of Los Angeles, who also built the Whittier exchange and is now adding to his list Downey and Norwalk, which will open up next month.



Southern California's Pioneer Independent Telephone Exchange.

The Los Angeles plant like the majority of the Southern California exchanges was built by the Empire Construction Company of Toledo, O., under the general managership of the veteran builder, Mr. F. F. Graves, assisted by his able superintendent, Mr. F. W. Wachter. The contract called for 3,000 lines and was completed and accepted by the Home Telephone & Telegraph Company, of Los Angeles, on or about September 1, 1903, having then something over 5,000 working lines. The remarkable growth of this new exchange can be seen from the report given out by its directors at the end of its first year. This report gives the net earnings for the four quarters as follows: $22,359,61, $31,817.51, $36,-474.93 and $37,921.22.



Monrovia's Independent Telephone System.

Los Angeles has a permanent population of about 120,000. Since this report was issued several sub-exchanges have been opened at Hollywood, Boyle Heights, East Los Angeles, Highland Park, Garvanza, Vernon and Prospect Park, which brings the total number of subscribers now connected to the Los Angeles exchange system up to almost 20,000; this includes over 100 private branch exchanges and intercommunicating systems. With the exception of Hollywood, which was the first branch, all of the branches are of the Strowger automatic type.

The equipment of all of the exchanges (with the above exception) are of the Kellogg full central energy type.

The Pacific States Telephone & Telegraph Company has waged a relentless war against the Independent movement on the Pacific Coast, but all to no avail, as the record shows one continuous march forward. Recently it has adopted the more sane plan of seeking to improve its plant and service. It will be noticed in the list given that in several towns the Bell Company is represented by very few subscribers, Monrovia, Covina, Compton, Smeltzer, Fernando, Glendale, etc. The most recent Independent exchanges are those of Riverside, San Diego and Ocean Park; all are full automatic of the Strowger type. Ventura has the Kellogg system. Franchises have been asked for at Uplands and Ontario where work is expected to begin soon. The temptation to build cheaply is very great, because of the climatic conditions, absence of lightning and storms of all kinds, but the Independents, benefiting by the experience of the Bell on the Pacific Coast, brushed aside the temptation and put in the most modern equipment known to the art, the construction being the equal if not the superior of any in the East. Recently the tendency has been to abandon open work and install the cable, and this policy will be continued for all time to come. The local companies have shown remarkable energy and enthusiasm in the work and have spared neither time nor money to make the movement a grand success, not only as units, but they have worked almost as one company, the greatest possible harmony prevailing throughout, they having but one goal and one ambition, that of giving the people the very best service possible at the lowest rates consistent with successful management.

As no doubt you have observed, the various exchanges throughout Southern California are separate companies, the territory having been distributed and assigned to the various companies by the construction company. It therefore became necessary to form another company to build, operate and maintain the very necessary toll lines connecting these towns and cities with each other. This company is called the United States Long Distance Telephone & Telegraph Company, no doubt named after its parent in the East and with which in time it will probably co-operate in connecting the East with the West. This company started out in a very modest way, having only a few miles of wire in use and but one toll position of two operators and ten lines; to-day it has about 500 miles of pole line carrying from 1 to 20 circuits per pole. An idea of the extent of this system can be seen from the map. Taking Los Angeles as a center its lines reach all beach points to the West and go as far east as Redlands and Riverside; to the north the lines reach Goleta, a small town north of Santa Barbara, and on the south they extend as far as Santa Ana. This line will soon be extended as far South as San Diego and the Mexican border. This company has recently made a specialty of farmers' lines, which act as feeders for the various trunk lines. It is also encouraging the formation of small local exchange centers, so much so that its business has almost doubled itself in the past year, and three toll boards of two operators each with a two-position recording and chief desk is too small to take care of the business and enlarged quarters are now being arranged for with a larger toll board capacity. It is now building 10 new metallic lines to Pasadena and 5 new metallic circuits to Redlands, San Bernadino and Riverside, all of No. 10 E.L.S. copper. It is also arranging to increase the number of lines to Whittier and Santa Ana and way points which are now overloaded. The construction is of a very high order and nothing but copper is used throughout.

WIRING FOR SAWDUST ELEVATOR MOTOR.

BY ARTHUR B. WEEKS.

Given a 1 hp. 110 volt two-phase alternating current motor on the fourth floor of a factory, for the purpose of conveying sawdust from the ground floor to a bin on the fourth, the device to be so arranged that when the sawdust door is opened, the motor will close a switch and set the machinery in motion.

Current can be taken from the lighting mains, one from each phase, and tapped as near the motor as possible, but not to interfere with office circuits, as the flickering of lights is often very annoying. The sawdust shaft must be protected against the possibility of fire, hence the outside door must be arranged and made to close tightly, and be covered with sheet iron. The entire shaft, if exposed, must be covered on the outside with metal; the bin must be lined throughout with sheet metal, and its door treated in the same way, both outside and inside. Place the motor on a small but well constructed wall bracket, or suspend from the ceiling, according to the style provided.

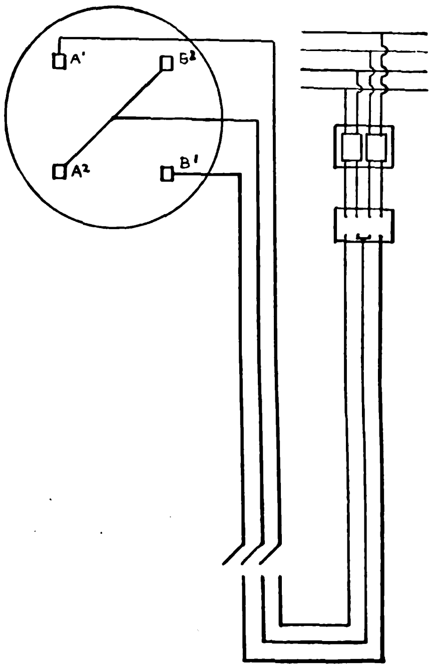


FIG. 1.

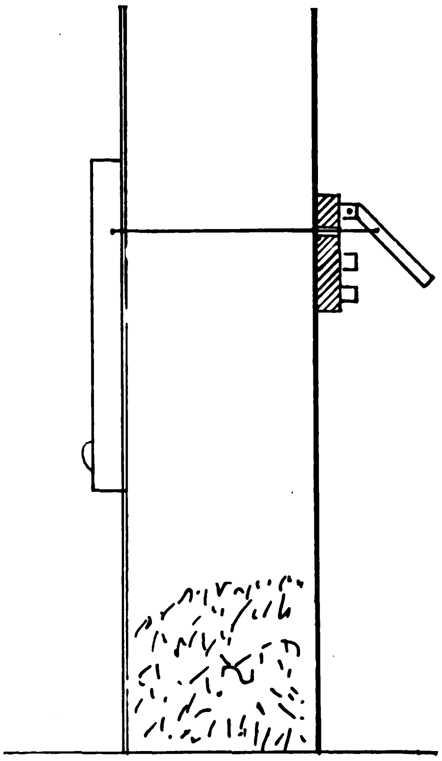


FIG. 2.

It will be observed in Fig. 1, that after leaving the switch there are but three wires employed. This means a great saving in wire and is accomplished by joining the two lower inside switch contacts with a wire, with the third or inside wire connected to this joining wire. At the motor A^2 and B^2 are connected by wire as shown, or A^1 and B^1, it makes no difference which. If on starting the motor it runs in the opposite direction from that desired, reverse the free wires A^1 and B^1, if connected, as shown in Fig. 2. This method of wiring is spoken of as changing from two-phase four wires to two-phase three wires. For so small a motor no auto-starter is required, nor is any external resistance necessary. To start, simply close the switch.

A 50 to 75 ampere two-phase single throw switch is required, together with two porcelain double pole main fuse blocks on the fourth floor. Use 25-ampere fuses. The wiring can be done in molding or conduit, preferably the latter. Use No. 10 rubber core wire.

If the elevator is only occasionally required, this small motor can be utilized for other purposes. If it is intended to operate the sawdust elevator only, the motor can be located on the floor which is most convenient as to space and accessibility.

A box elevator could also be operated by this motor, having the inclined shaft on the outside of the building, and operating by means of a friction clutch. It would be best, however, not to run both at the same time. A friction clutch could be used with the sawdust elevator shaft, or the belt can be slipped off its pulley if desired. Should both be operated at once, a fuse will be liable to blow at times, and the replacing of fuses may be annoying, if the wiring is such that several fuse blocks are required. If it was a direct current circuit, the solution would be very simple indeed; but from the fact that there must be a two-phase circuit, and that in all probability there is only a single phase feeder circuit in the block, and that it may be necessary to run a long circuit from another building, the case will be worse still if fuses blow on two or three sets of fuse blocks.

The idea should be then to eliminate all fuse blocks possible, even using wire as far as the motor, with the same size as the feeder if necessary, so that to this point no fuse blocks will be required. Then fuse at the motor, as shown in the illustration.

Hunting around with ladders for blown fuses is one of the worst nuisances imaginable. If the fuss on one phase blow, the motor will stop and cannot be started until re-fused. Flash the switch to see which phase shows no spark; or better still, connect two 110 volt lamps in series, this being a 110-volt circuit, and 220 volts across certain leads of the three-wire circuit. Testing at the upper leads at the fuse blocks will of course give but 110 volts maximum.

An electrician was once called to start a motor connected as herein illustrated, and when all the tests had been made and fuses examined and found to be intact, with no broken wires nor loose connections, it still refused to start. He made sketches of the wiring, and wondered what could possibly be wrong. Stepping into the engine room to talk it over with the engineer, he found a switch open, left so by mistake and unnoticed by anyone else. It cut off current from one phase.

When assuming charge of a new plant, one sometimes finds conditions which lead to all sorts of problems. It takes time to make changes, as well as expense. Some firms, seeing no necessity for making improvements or changes in wiring, when they are not aware that it has given trouble, veto the improvements. Electricians are therefore judged by the condition of circuits, motors, etc., sometimes when they have no control over conditions, being under the supervision, perhaps, of a master mechanic, who is not discriminating in electrical work, being purely a mechanical man. This at times accounts for conditions found in shops, and is not the fault of the electrician.

Electrically Operated Plow.

A plow operated by electricity is being constructed by a Minneapolis firm. The plow will be run by trolley on an adjustable wire, and the current will be furnished by a dynamo set up in one corner of the field.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

THE TRANSMISSION OF POWER.

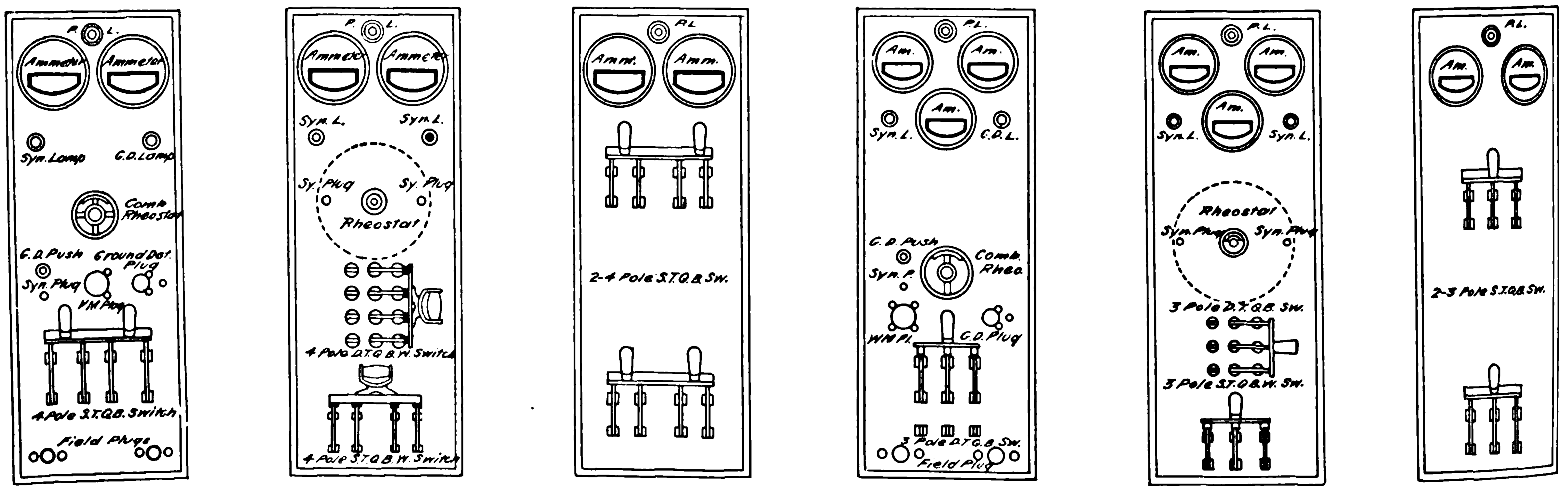
Switchboards for Polyphase Circuits.—The control of power circuits is best obtained by the use of special switchboards so designed that the apparatus necessary to exercise this control is conveniently situated for use. In order to simplify the arrangement of these various devices the switchboard is considered in an analytical manner and the apparatus attached to it classified with respect to their individual functions. It is to be noted, however, that the switchboards themselves and the apparatus they contain may be divided up into low potential switchboards and high potential switchboards.

Low Potential Switchboards.—The elements of a switchboard of this character may be regarded as consisting of the following:

PANELS OF A LOW POTENTIAL SWITCHBOARD.

1. Generator panels.
2. Feeder panels.
3. Rotary converter panels.
4. Polyphase motor panels.

The construction or manufacturing department of large concerns make panels of this character their standards. A switchboard is therefore built up of a series of parts as enumerated. They are called panels and as such are held together by means of a frame consisting of a rectangular iron support resting on ornamental legs. Clearance between the floor and the lower part of the frame of about 2 feet completes the design. The iron legs are broad and removable. In case extra panels are required, these legs may be removed and marble panels inserted mounted with whatever apparatus is necessary. Some of the panels below, in this case, will be set in blank.



No. 1. No. 2. No. 3. No. 4. No. 5. No. 6.

No. 1—Two-phase Generator Panel. No. 2—Two-phase Rotary Converter Panel. No. 3—Two-phase Feeder Panel. No. 4 Three-phase Generator Panel. No. 5—Three-phase Rotary Converter. No. 6—Three-phase Feeder Panel.

The general list of apparatus employed on the switchboard is comprised in the following schedule:

1—Indicating voltmeters.
2—Field ammeters.
3—Swinging voltmeters.
4—Switches.
5—Rheostats.
6—Synchronizer.
7—Ground detector.
8—Fuse blocks.
9—Transformers.
10—Compensators.
11—Wattmeters.

Indicating Voltmeters.—Instruments of this description are employed for the purpose of enabling the switchboard attendant to obtain the voltage of any phase of the system or of any generator by the use of a plug switch inserted into a voltmeter receptacle.

Field Ammeters.—The field of the generator carries current, the amperes of which it is desirable to know. Means are therefore employed to connect one or more ammeters into the field circuit for the purpose of determining this current when desired. The name field ammeter is sometimes given to this instrument when so utilized.

Swinging Voltmeters.—Voltmeters of this description simply swing from the side of the panel by means of an arm or bracket. When a second generator panel is installed for the purpose of operating more machines in multiple, the use of another voltmeter becomes necessary and a voltmeter is therefore installed to occupy a place beside the first in the bracket or swinging arm. A means of ready comparison is thus instituted between the two voltmeters and the pressures of each generator examined for differences. It also possesses the advantage of giving a good view of these two instruments from any point of the switchboard.

Switches.—These devices are naturally required to make and break quickly. The time in making contact and the abruptness in breaking it are matters of the greatest importance in this class of equipment. The switches are made with three and four-pole contacts, suitable as a little reflection will show, to the phases they make or break. What are called "spade handles" are provided with the four-pole switches and a handle of special construction, called by the manufacturers reinforced, for the three-pole switches.

Rheostats.—The back of the generator panel holds the rheostat. Before entering further into a brief description, it is well to state that the rheostats are of two types—one for the exciter and the other for the generator. Handwheels are employed to turn the contacts which do not appear on the face of the panel. Only a dial is seen with a movable index. This gives a relative idea of the operation of the rheostat when varied by means of the wheel handle. In some instances the rheostat is employed at a distant point from the switchboard and only the face plate with its various connections led to the panel. The generator referred to is the alternating current machine into whose field circuit the exciter feeds. Both the exciter and the alternator fields are therefore controlled by individual rheostats as described.

Synchronizers.—When two or more alternators are to be thrown into multiple it is necessary to use a device which will show when the current waves are in unison. Unless this is attended to interference will result and the lamps flicker constantly. A synchronizer is therefore employed by means of which the machines can be thrown together without risk in this respect. When the generators are run in multiple, the generator panel receives the individual currents from each machine and it is delivered through a switch to the bus bars. Every separate circuit possesses an ammeter. If there are different phases, an instrument for measuring current is also employed. If the generators are run in multiple, from each generator panel connections are made to provide them with a synchronizing lamp.

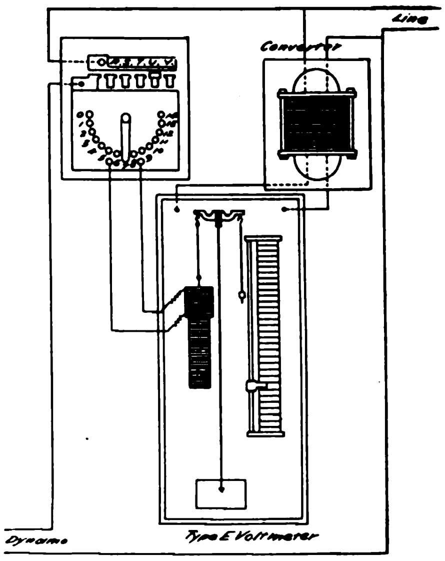
Ground Detectors and Fuse Blocks.—A ground detector is a device by means of which any leg of the circuit may be tested for grounds. The use of two lamps in series, connected to the ground at the point of connection between the two lamps, and so arranged by means of a switch that a test may be made as desired, constitutes the general character of the apparatus. Whichever lamp burns brightest indicates the position of the ground. If the lamp connected to the right hand leg burns brightest the left leg is grounded and vice versa.

Fuses for alternating current service are generally mounted on porcelain backings, which in turn are contained in an iron box. They are specially protected with regard to the lineman. When blowing the operator is protected from injury by the position they occupy in the porcelain foundation. Transformer fuses are made single or double pole. Lead wire is dispensed with for all currents over 10 amperes. Beyond this point copper is frequently employed although aluminum is also desirable. A type of porcelain tube is employed which forms part of the porcelain foundation and which occupies a front position in the forward part of the fuse block; this contains the fuse and, as previously mentioned, protects the lineman whether the box is near his hands or not, or whether it is opened or closed. In some designs of fuse blocks the porcelain tubes are readily removable. As they contain the fuse itself, it is readily evident that the removal of this tube and the insertion of another involves no risk of dangerous contact. The fuse, when blowing, expels the volatilized metal through the porcelain ends and thus protects the device from injury. It is to be understood that a fuse box must be waterproof. The presence of moisture would rapidly invite electrolytic and other actions. Heavy grounds, ultimately resulting in short circuits, would be incurred if it were otherwise. Special means in the shape of bushings are used to exclude all moisture from metal parts which might be injuriously affected.

FUSE BOX DATA.

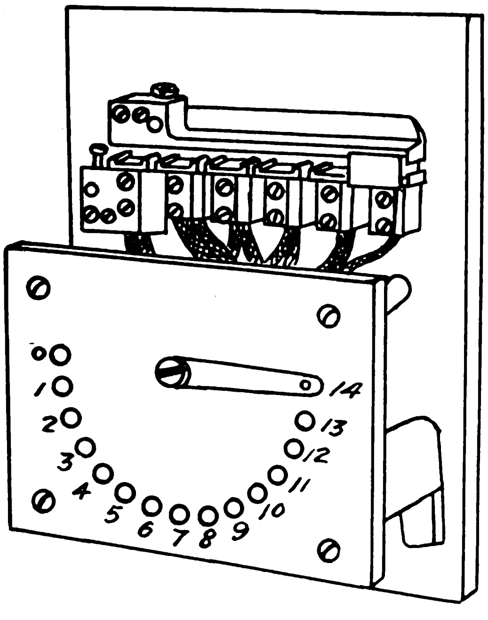
Voltage.	Maximum Current.	Information.
1,000	10	Double pole in cast-iron box.
2,000	2	
1,000	10	Double pole without box.
2,000	2	
3,000	30	Double pole in cast-iron box.
3,000	30	Double pole without box.

The Compensator.—The description of the purpose and function of the compensator is comprehensively stated in the pamphlets of manufacturers of this class of apparatus. It is inherently useful in indicating the pressure at the point at which the current is consumed. In this respect the power plant pressure is greater as can be readily understood, but the compensator fulfills the peculiar purpose of correcting the voltmeter indication of this drop between the two points. The transmission of power problem involves the sustaining of the correct pressure at the points, not only of distribution, but of consumption as well. The termini of the feeding system must therefore be watched carefully to remedy any great difference in pressure between them and the station proper. The ohmic drop is readily understood as being dependent upon the resistance and current. These, in their place, are necessarily dependent upon the dimensions of the feeders and the load they carry. With but one circuit, the problem is simple in its nature. With many, however, it represents complexities that invite the use of the device to be described. The complexities are those due to the same station or generator particularly supplying current to circuits in which conditions exist which call for independent regulation in each. One manufacturing concern argues as follows: "In some cases where the load varies over a wide range it may be advantageous to permit a considerable drop during the limited time that full load is supplied in order that the first cost of the line may be reduced. This necessitates supplying at the power station a voltage considerably higher than that required at the load. In other circuits, carrying a full load most of the time, it will be more economical to install a conductor of large current carrying capacity, at a corresponding increase in the cost, so that the percentage of drop may be kept within reasonable commercial limits. In these cases the voltage supplied at the power station will be but a few per cent. higher than that required at the load. It is evident therefore that in many cases the cost of transmission circuits can be considerably reduced providing suitable regulating devices are installed at the station. It is also important that means be provided at the power station to indicate the EMF. at the load, otherwise it is impossible for the attendant to regulate the voltage properly. The old method of accomplishing this was to run small wires, called pressure wires, from the end of the circuit back to the station, these wires being large enough to carry a sufficient current for the voltmeter without an appreciable loss. This method was quite expensive and if carried out to any degree of completeness resulted in a great deal of complication. It is evident that the cost of installing pressure wires is prohibitive when the feeders cover the great distances which are now common in lighting and transmission plants. A simple, inexpensive and thoroughly effective method of accomplishing the same result is afforded by the compensator."



Connections of the Compensator Converter and Voltmeter.

Compensators are made of two types, one to serve in compensating for ohmic drop only and the other to compensate for both ohmic and inductive drop. The attendant in charge of the ohmic drop compensator can readily adjust the pressure until the candle power of distant lamps is normal, irrespective of the intervening drop. Wattmeters and transformers have received attention in the preliminary treatment of this subject. The compensator is a transformer, according to the description given by one manufacturer, the primary of which is connected in series with the supply circuit. The number of turns in the primary coil of this device are capable of variation. They may be adjusted and the same is true of the secondary; but the secondary is connected to a volt meter. The result of this system is as follows: "As the load on the circuit increases, current through the primary increases, and the action of the secondary current on the voltmeter increases. In some types of compensators the secondary is connected in series with the voltmeter circuit. The secondary of certain standard types is connected to an auxiliary coil wound around the voltmeter solenoid. The action is similar to that of the series coil on a compound wound generator. The current from the compensator is opposed to the current in the solenoid and as the action of the auxiliary coil increases, the current through the main solenoid must be increased in order to give the same resultant pull on the core. This requires a higher pressure on the voltmeter itself, and consequently an increased pressure on the circuit. The amount of compensation depends upon the number of turns in the auxiliary coil."



Compensator with Adjusting Arm and Contacts—Four-Hand Regulation.

In the illustration the connections are shown, including the R, S, T, U, V plug contacts and the auxiliary coil around the voltmeter solenoid. The adjustment of the secondary is also shown where the numbers 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 are visible. This last governs the current in the auxiliary coil around the voltmeter solenoid. Compensators are made for an amperage of 160 or less and a frequency of from 16,000 to 7,200 alternations.

In more highly developed types, irrespective of the nature of the load, the current, power factor, reactance and resistance are all taken into account. Special adjustment is made in allowing for ohmic and inductive resistance when compensators are installed.

THE ORGANIZATION OF WORKING FORCES IN LARGE POWER HOUSES.*

BY W. P. HANCOCK.

The electrical portion of the organization of a power-house is divided into six parts, the most important of which are:

First—A uniform pressure at the feeder terminals throughout the entire system.

Second—The proper and economical loading of machinery under the charge of the division; and,

Third—We hold this division responsible for the welfare of all electrical machinery, which must be, as far as possible, always ready for operation.

I may say that all repairs, except minor ones, in the division are done by outside parties. With the modern stations of to-day operating lighting and stationary motors and other low-tension apparatus, at the same time delivering alternating current to sub-stations, there is involved a vast amount of apparatus, due to the fact that we must have as much flexibility as possible. We must also have several ways of attaining the same object, as to the delivery of current, in order to safeguard our customers against interruption of service and, incidentally, preserve our reputation for being a reliable concern to deal with. It follows then that we need in a chief operator a man who is absolutely reliable, preferably one who has come up from the ranks and has long since become acquainted with the practical side of operation; one who realizes and instills into the minds of his assistant and men that one of their most important duties is so to manipulate the load with reference to machines to be operated that all units will be loaded to just as near the most economical operating point as it is possible to have them under the existing conditions. He must at all times be in close touch with the chief engineer, and as far as possible, give the steam division advance notice of his probable demand for steam units, thereby giving everybody a chance to be ready, and giving the customer the opportunity to verify our claim that we are at all times ready to supply current. Above all other things, he must have and use good judgment in the selection of his men and the treatment of them, and must conduct his division in a manner that will not only produce satisfactory service, but will be conducive to contentment among his men and will secure for himself their confidence and respect, which once secured and properly held will be a large factor in maintaining what is as nearly as possible ideal operation.

He should always follow the system of hiring new men at the lower end of the line, and moving those who have acquired a degree of proficiency along to a proper position in accordance with such proficiency, thereby giving them the encourment of understanding that the greater their proficiency the more valuable their services will become to the company, up to a certain limit in that line of work.

ASSISTANT OPERATOR.

The assistant to the chief operator must be a man who can assist his superior, and to that end he must be thoroughly familiar with all of the electrical apparatus in the division. He must be able to occupy the position of the chief operator when necessary; in fact, he must be a first-class understudy, and must realize the fact, too, or he will lose to some degree the sense of his responsibility. He should circulate among the sub-stations and correct and report any irregularity noticed in machines or operators; in fact, he should keep his superior constantly in touch with such details as do not come immediately under the notice of the chief operator, and in cases of emergency should come at once to the station and be ready to assist if needed.

The assistant should also be extremely careful about the placing of his orders with the men, and in matters outside of absolute routine place no orders without the consent of his superior; many mistakes are avoided if every one concerned is conversant with what is to be done, and with our means of communication in these days, not much time need be lost in giving notice.

WATCH OPERATOR.

The heads of watches should be, and necessarily are, men who have come up the line and who understand all the electrical combinations that can be made with machines, switches and lines throughout the system; if they are not, they should not occupy that position, nor should they in any case until we know by actual experience that they have the ability described above.

To these men we accord the highest wages paid in the division, with the exception of those of the chief operator and his assistant, and we make them uniform in all power stations of the system. By this method of making men fit the position before they occupy it, we secure the ability we desire, and after it has been proven beyond doubt by a previous practical experience. It is, in my opinion, a serious mistake to class men alike for the sole reason that they have worked practically side by side on the system for a period of time. I say, pay the man in accordance with what he can deliver to you in brains or manual labor equivalent. I admit that the man who can not deliver the first-named portion of a working man's capital, and won't deliver the last item, may conclude to get off the pay roll and identify himself with some organization or other which may demand that all of its members receive the same wages. If he does this, it is his affair; but we can not afford to pay the same price for ignorance and neglect that we can for ability, aided by push and a desire for further knowledge. In making this statement I do not mean to cast any reflection on a man that may have less ability than others, but instead to speak from a purely business point of view, and I repeat, that the chief operator when hiring men should be particular to move along the best ones, and be still more particular when he takes in his green workmen to observe to the best of his ability, and satisfy himself thereby, of the apparent future value of the men. This is the proper method to adopt in order to keep the organization up to standard; that is to say, it is the proper beginning, and let it extend down to the end of the line, even to the cleaners, for there are good cleaners and bad ones, especially on electrical machinery.

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*Abstract of paper read before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11., 1905.

STORAGE-BATTERY DIVISION.

Of the organization to operate storage batteries, I will say I believe that the cheapest man to have at the head is one who is both technical and practical in that line of work, and that he should be possessed of the same qualifications as are necessary in other heads of divisions with reference to handling men; but there is this to add, that it is seldom that men will work in the general line of storage-battery repairs for any considerable length of time, in that such work is not of the sort that attracts the average man, and they do not stay long enough to actually show of what value they might be after a reasonable period of service.

HEAD OF DEPARTMENT.

I have refrained from speaking of the head of the generating system and the assistant to that person, for the reason that it seemed to me proper to look over what there was in the nature of organization and operation that the head and his assistant were called upon to look after. I now say that the head of the department has responsibilities as follows:

First—The very important one of the organization of his department. If that be correct, or as nearly so as conditions will permit, the operating responsibility, broadly speaking, will not seem as serious to the head of the department as it would under the more unfavorable condition of lax discipline in the handling of heads of divisions and men who have severally decided that the head of the department is in his position for the sole purpose of bearing his title instead of directing the operation of the generating system. He should not only pass his orders on operation to his assistant, but in addition should see to it that they are carried out. He should carefully observe the result, and be ready to devise, if possible, methods of saving to his several accounts, as the total of these will represent his total generating cost. He should not, however, overdo the looking after of small details, for several reasons. First, because he has an assistant and several heads of divisions, who occupy positions and are paid salaries for the purpose of looking out for that portion of the business, and if they don't do it and relieve him in that direction, then either the organization or the discipline or both are not corrrect, and it is absolutely useless for him to expect to proceed on a successful basis until his own error, whether caused by neglect or otherwise, is corrected, and his people understand in a thorough manner that the head of the department is there to direct its operation.

The head of the department should also keep in touch with the intentions of his heads of divisions relative to their hiring of men, and not only confer with them in a general way on such matters, but lay down a rule that men connected in any way with matters detrimental to the interests of the corporation should not be hired in any event. He should include in such a rule a stipulation that if men of such type can get inside the organization notwithstanding proper precaution has been taken, they should be relieved from further connection with the department at once and be replaced by men of a different class.

I have found by some years of experience that to pay one line of work a standard wage, whether it be lower or higher than the so-called "union" scale, is productive of more contentment and better sentiment toward the employer than anything else I know of, but in order to do this consistently we must, as I have mentioned before, be careful to select a class of men who are very nearly alike with reference to the amount and quality of work which they can perform. Such a thing can be done easily, as I know by actual experience.

It does not seem necessary to say that the head of the department should not absent himself from the system or from his office for any length of time without giving notice where he can be found in case of emergency, and the assistant and heads of divisions should be required to observe the same rule; for while such a rule may seem to be somewhat of a hardship at first, on second thought we can easily imagine cases where it would be most unfortunate not to be able to avail oneself of the services of one of the best men in his department just because one is unable to locate him; and besides, such a rule removes any chance of inference being drawn which might be detrimental to the man.

The head of the department has at times to go farther than his office to get at the reason of the rise in some account which seems abnormal. He must, after exhausting other methods, simply get in and dig it out; get the reason, and see if it is a proper one, and if not, apply the remedy. If the reason is proper he is entitled to rest content, because he has assured himself that the rise in the account is not the result of reckless expenditure; if he finds a poor reason, he will strengthen his organization by taking the matter up with the proper party and going into it in a manner that cannot be misunderstood, and show where it is to the advantage of all concerned to make that expense nearer the proper amount.

It sometimes happens that difficulty occurs between some of the men and their superior, in which the man from the ranks feels that he has been misused; that his superior has been too hard on him because his advantage of position has given him the privilege. In such cases, after the man has taken his trouble to the chief of his division and even then feels that he has a grievance, I believe it to be good policy to allow him to see the head of the department as a last resort; for the head to call in all parties concerned at one time and hear the several stories, one at a time, and decide the matter. Of course, if the superior has used his position properly there can be but one result; if he has not, and you have to decide the man is not to blame, then be sure you have that man understand beyond a doubt that he can not and must not mistake a just decision for a license to disobey in the future, but that he is bound to work for and obey the same superior, just as much as he was previous to the time when the difficulty ocurred.

It therefore seems that there are a good many places where the head of the department can put in his services and benefit the organization, and if he can find the necessary time to walk out and through his system, even though he does not speak at all, no doubt he can see spots that will bear criticism, and it is for him to note them and, as I said before, "apply the remedy."

For the head of a department to say to himself, "We are now organized and operating satisfactorily, there is nothing more in that line at present," is a rash statement even to himself, as he will soon find out if he does not watch what he has tried to put together so carefully. To watch the organization, and constantly, too, is what is in a large degree necessary to the attainment of a low cost per kilowatt-hour.

WRINKLES.*

EDITED BY H. C. ABELL.

Booster Transformer.

We have used a transformer for a booster, as shown in illustration, and while to many it is not new, yet it is so to some central stations. The transformer must be large enough to carry the main line current in section coils. We wanted a 5 per cent. boost on a line temporarily and found this one way to obtain the results. H. E. RYDER.

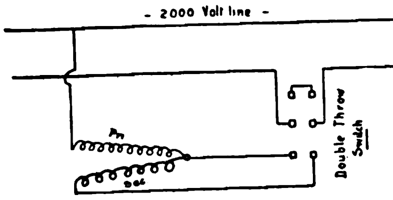


DIAGRAM OF CONNECTIONS.

Direct Current Power Machines at Sub-station Driven by Synchronous Motor.

These power machines feed into the same lines as the engine-driven power machines at the main station. The motor-driven power machines are used as motors, taking current from the main station to bring the synchronous motor to speed at starting.

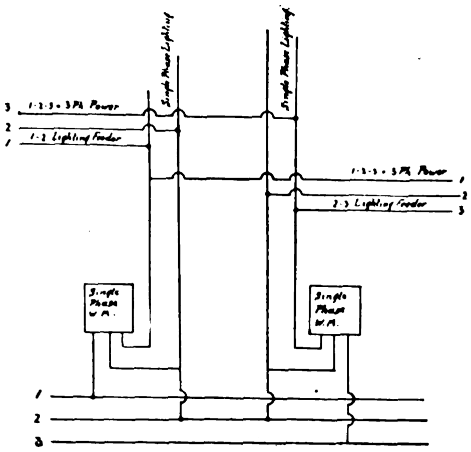
The motor current in the series field winding of the machines overpowers the shunt winding, so that the machines refuse to start and produce practically a short circuit upon the lines, opening circuit breakers, etc. Switches were placed upon the machines for reversing the connections of the series winding at starting. After the motor is synchronized and the power machines loaded the series coils are cut out by means of a single-pole switch, while the reversing switch is thrown over to give the proper compounding effect.

It is often desired to run this apparatus through short periods of small loads rather than shut down and start over. When the load drops as low as one-quarter full-load equilibrium becomes unstable, due to the absence of an equalizer, the load all being taken by the main station. Worse than this the power machines begin taking current from the lines and supply energy to the alternating current lines through the synchronous machine. The increasing motor current in the series winding of the power machines overpowers the shunt winding, causing the torque to pass through zero and reverse, coming up so high as to pull the alternator out of synchronism. The remedy for all this is, of course, to throw the reversing switch to the starting position when the load is small, making proper voltage adjustment by the shunt field. The equilibrium is then stable.
J. M. WEED, Denver, Col.

Taking Three-Phase Power from Two Single-Phase Lighting Feeders.

The accompanying diagram shows a scheme for taking three-phase power from two single-phase lighting feeders when these feeders are tapped, as shown, on all three 'bus bars by simply running one extra wire to the point where the motor is located.

You will note that the three-phase power is recorded by two single-phase wattmeters, at the same time taking care of the single-phase lighting load, whatever it may be. The potential, current and static transformers are purposely left out of the diagram, to avoid complication, our 'bus bars being 2,300-volt, three-phase. We give C.R. voltage regulators in each single-phase circuit and can therefore keep the lighting voltage anywhere we want it. We use this scheme on one single-phase lighting feeder that runs two miles to the outskirts of town, along which are many lighting consumers. We simply run one extra wire, tapping it off the current meter side of the other single-phase feeder. AUSTIN BURT, Waterloo, Ia.



WIRING DIAGRAMS.

Exciter for Synchronous Motor.

This company recently installed a 400-kw. synchronous motor at one of its stations, to be used both as a feeder regulator and to drive two direct current machines belted to it. Its operation was very unsatisfactory, as the incandescent feeders, operated from the same 'bus bars, gave a very noticeable flickering of the lamps, the voltage varying constantly two volts either way from an average.

We thought the trouble due to the fact that the exciter was run from the synchronous motor shaft, and accordingly belted it to a separate motor run from a separate feed. This has obviated all fluctuations and the entire set is now giving satisfaction. C. F. HAYWOOD,
Denver, Col.

Apprentices in the Electrical Trade.

Beginners in the electrical trade are wanted by the General Electric Company at its factory in West Lynn, Mass., and the company announces the following rate of wages: To graduates of high schools only—drawing office apprenticeship course, $5.33 per week for first six months, $6.30 per week for second six months, $7.28 per week for third six months, $8.25 per week for fourth six months, $9.22 per week for fifth six months, $10.67 per week for sixth six months. There will also be a bonus of $75 distributed if the three years of service have been satisfactory. Shop apprenticeship course, $4.48 per week for first six months, $5.60 per week for second six months, $5.72 per week for second year, $7.84 per week for third year, $9.24 for fourth year; bonus of $100 at expiration of term if services have been satisfactory. For high school students and grammar school graduates—shop apprenticeship course—$3.36 per week for first six months, $4.48 per week for second six months, $5.60 per week for second year, $7 per week for third year, $8.40 per week for fourth year; bonus of $100 at expiration of term if services are satisfactory.

Electrical Contractors' Convention.

The National Electrical Contractors' Convention at Boston last week was attended by 175 delegates. The proceedings were conducted with closed doors.

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*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

Automobile Dealers Incorporated.

The National Association of Automobile Dealers, to promote and advance the mutual interests and welfare of its members and to harmonize their relations, was incorporated at Albany, N. Y., on Monday. The association is to have its principal office in Buffalo.

Exhibit of Traction Supplies.

The south pavilion of the Commercial Museum has been secured by the American Street Railway Manufacturers' Association for an exhibit to be given in connection with the annual meeting of the American Street Railway Association, to be held in Philadelphia, Pa., September 25-30, inclusive. Secretary George Keegan, of the latter association, has issued a circular letter advising all intending exhibitors that another large building will be available in the event of the south pavilion being filled. More than 75,000 square feet of floor room will be offered for use and two railroad tracks, more than 1,000 feet long, will be constructed for outdoor exhibition purposes.

Out-of-Door Electric Signs.

A recent visit to the West proved to the writer that the merchants and manufacturers realized the value of electrical display signs. In many cities nearly every business house had its electric sign, and this means of advertising has proved so valuable that it is finding a ready welcome in the East.

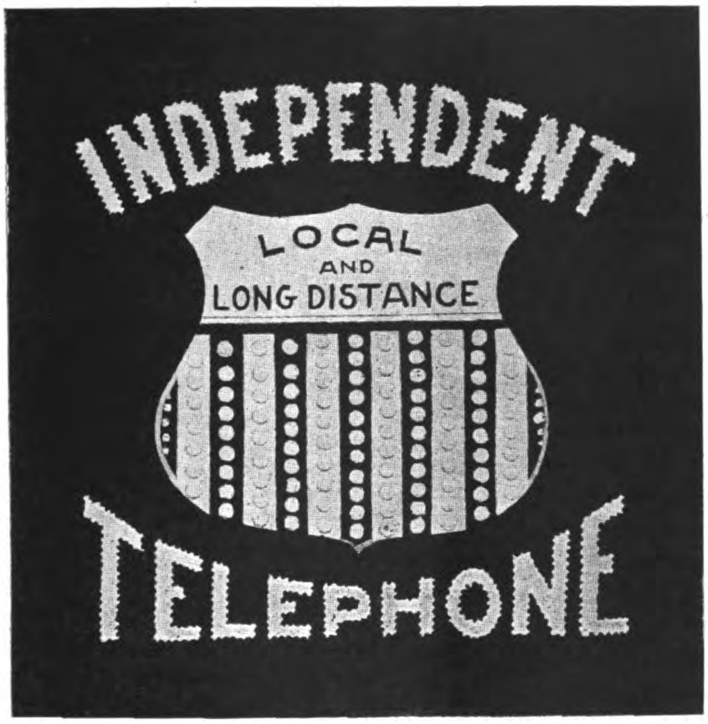
Nothing contributes more to the attractiveness of a business street or place of business than a harmonious electrical display, and the American Electric Sign Company, 41-45 West Van Buren street, Chicago, has forced itself to the front as a leader in this style of advertising. Its enterprising manager, Mr. H. C. Dodge, has pushed the electrical sign method of advertising so extensively in the West that he has nearly covered the entire field and he is now turning his attention to the East.

These signs combine lightness of weight, strength and durability; are easily handled, easily hung and adapted to be safely shipped to distant points; are lighted from the interior, and cost of current required to produce effective illumination is moderate.

All that is necessary in ordering a sign is to state the voltage of the incandescent lamps you burn. Signs are ordinarily provided with 110 volt lamps with Edison style of base attachment plug on end of connecting cord for Edison socket, and the flasher adjusted for use with current of 110 volts pressure.

The American Electric Sign Company assures us that the signs are attractive in the daylight when not illuminated, but that when the flasher is in operation, it conveys a suitable impression of the attractive prismatic blending of colors which illuminates the lettering and various designs on the slides through the medium of the electric light.

The company will be pleased to send you illustrated circulars describing the flashlight and outdoor electric signs, and the illustration herewith shows the appearance of the signs, minus the coloring.



ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 18, 1905.

Electric Railways and Appliances.

794,784. Block-Signaling System. Harry M. Coulter, Chicago, Ill. Filed Sept. 5, 1903.

795,016. Trolley-Ear. Montraville M. Wood, Schenectady, N. Y., assignor to the General Electric Company. Filed Jan. 15, 1902.

795,243. Railway-Brake Apparatus. Granville T. Woods and Lyates Woods, New York City, assignors to the Westinghouse Electric & Manufacturing Company. Original application filed Dec. 31, 1902. Divided and this application filed April 10, 1903.

Electric Lights and Appliances.

794,839. Electric-Arc Lamp. Malcolm H. Baker, New York City, and Samuel P. Wilbur, Wilkinsburg, Pa., assignors to the Westinghouse Electric & Manufacturing Company. Filed Jan. 10, 1903.

794,902. Arc-Light Electrode. Friedrich O. Vogel, Berlin, Germany. Filed July 6, 1903.

794,924. Application of Electric Lights to Revolvers or other Firearms. Eugene C. I. Caillìez, Lens, France. Filed Jan. 6, 1904.

Electrical Machinery and Apparatus.

794,742. Soldering-Nipple for Electric Cables. Henry E. Procunier, Oak Park, Ill. Filed July 22, 1903.

794,820. Automatic Rheostat. Carson J. Sturgeon, Erie, Pa., assignor to the Federal Electric Company, same place. Filed Feb. 4, 1904.

794,886. Support for Dynamos. Willard F. Richards, Buffalo, N. Y., assignor to the Gould Coupler Company, New York City. Filed Sept. 27, 1904.

794,935. Electric Switch. Monroe Guett, Hartford, Conn., assignor to the Hart & Hegeman Manufacturing Company, same place. Filed Nov. 1, 1904.

794,995. Alternating-Current Motor. Maurice Milch, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 21, 1903.

794,998. Dynamo-Electric Machine. Frederick A. Mott, Erie, Pa. Filed Nov. 27, 1903.

795,000. Motor-Control System. William O. Mundy, St. Louis, Mo., asssignor to the General Electric Company. Filed Feb. 20, 1903.

795,024. Pneumatic System of Motor Control. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company. Filed Dec. 5, 1902.

795,077. Power-Transmission Gear. Erick J. Swedlund, Atwater, Minn. Filed April 10, 1905.

795,170. Electric Brake. William G. Price, Pittsburg, Pa. Filed Aug. 17, 1904.

795,235. Electrical Switch and Operating Mechanism Therefor. Willard F. Richards, Buffalo, and William A. Turbayne, Lancaster, N. Y., assignors to Charles M. Gould, New York City. Filed April 9, 1904.

795,247. Current-Collecting Shoe. William M. Brown, Johnstown, Pa., assignor to the Lorain Steel Company. Filed Jan. 26, 1903.

795,256. Method of Operating Multistage-Turbines. Austin R. Dodge, Schenectady, N. Y., assignor to the General Electric Company. Original application filed Nov. 7, 1902. Divided and this application filed Jan 23, 1904.

Telephones and Telephone Apparatus.

794,790. Intercommunicating Telephone System. Albert S. De Veau, New York City, and Charles Auth, Brooklyn, N. Y. Filed Sept. 2, 1902.

794,967. Telephone-Support. Edward P. Baird, Evanston, Ill., assignor to the Baird Manufacturing Company, Chicago, Ill. Filed Dec. 19, 1904.

795,072. Cut-Out for Telephones. Martin L. Smith, Rutledge, Mo., assignor of one-half to Sherman C. Forguer, same place. Filed June 7, 1904.

Miscellaneous.

794,768. Electrically-Operated Keeper-Plate for Door-Locks. August Arens and Ernest L. Teich, New Britain, Conn., assignors to to P. & F. Corbin, same place. Filed Feb. 30, 1905.

794,788. Shield and Support for X-Ray Tubes. Levitt E. Custer, Dayton, and David H. Allen, Miamisburg, O.; said Custer assignor to said Allen. Filed April 6, 1903.

794,864. Electric Battery. Pierre J. Kamperdyk, New York City. Filed April 2, 1904.

795,182. Protective System for Parallel Lines. Leonard Wilson, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, same place. Filed Nov. 20, 1903.

795,201. Electrically-Heated Handhold. Fred S. Davis Robertsville, S. C. Filed Dec. 29, 1904.

THE TELEPHONE WORLD.

New Entry in Telephone Field.

Articles of incorporation of the Atlantic Telephone Company, with a capital of $5,000,000, were filed with the county clerk in Kings County, N. Y., last week. All the stock is common stock, each share being of $100. The objects of the company, as stated in the papers, are to furnish telephone, telegraph, telautograph and other means of electrical communication and messenger service in the cities of Buffalo, Syracuse, Rochester, Albany, New York and other cities on the Atlantic coast.

The incorporators are William H. Stayton, Yonkers; James A. L. Campbell, Charles B. Reid and James G. Shaw, of New York City; George H. Newman, Brooklyn, and Warren L. Sawyer, Nyack.

One of the incorporators recently said that he had every reason to believe the company would be sending messages in a short time.

Telephones on barber chairs are the latest innovation in Paterson, N. J., and so popular is the plan that before long it is expected other barbers in that city will have telephones installed. The barber in charge says that he put in the telephones as an experiment, and he has been congratulated by several of his customers, who are unanimous in their opinion that, while the plan is a novel one, it is soon to become popular in other places.

The management of the Keystone Telephone Company of Philadelphia has been reorganized with N. P. Folwell, president. There are seven new directors, only three of the old board being retained. A board of voting trustees with George Burnham, Jr., chairman, is organized for seven years. By the recent sale of $4,000,000 bonds to Fisk & Robinson, the company is free of debt, has $750,000 cash in the treasury and is free to make some desired extensions.

The People's Division of the Consolidated Telephone Company, of Pennsylvania, has secured possession of rural telephone lines touching Lake Winola, Newtown and Ransom Townships, Nicholson, Factoryville and Tunkhannock. These lines give the People's Company direct communication with the entire farming section of Northeastern Pennsylvania.

There are said to be nearly 50 different rural telephone lines in Crawford County, Kan., owned by farmers. Of these 28 center in McCune and six in Girard.

The Comfrey, Minn., Rural Telephone Company has its local exchange and rural lines nearly completed. The officers of this company are J. A. Prim, president; C. L. Tindersmith, vice-president; Oscar Erickson, treasurer The company will start out with about 75 'phones.

The Farmers & Merchants' Telephone Company, of Harlan County, Neb., is rebuilding its exchanges at Alma, Stamford, Republican City and Orleans and when remodeled and the cable installed, it will have one of the best systems in the southwestern part of that State.

The Quinton, I. T., Telephone Company plans to have its exchange in operation August 1.

To Sell Telephone Company.

Trustees Kinthard and Atkinson, on an order of the Court of Common Pleas, of Bucks County, Pa., will sell at public sale the entire equipment of the Standard Telephone & Telegraph Company on August 12. The upset price fixed by the court is $24,000. The property inincludes three pieces of real estate in Doylestown, Newtown and Bristol.

Successful results have been secured by the profit sharing plan of the Cuyahoga Telephone Company, of Cleveland, O. The distribution is made each six months, based on the earnings of the company for the half year period preceding. The plan was introduced for the purpose of inducing the employes to remain permanently with the company, President Dickson arguing, that a force well organized and experienced, was worth a great deal more to the company than a force where changes were continually made. The amount to be distributed will be in excess of $8,000, and will be about one-third larger than any previous distribution. The former distributions have been amounts about equal to 6 or 7 per cent. increase in salary. There will be more than 9 per cent. distributed in a short time. The distribution includes all of the employes in the various departments who have been with the company the full six months, from the office boy to superintendent.

The board of public works of Marion, Ind., has been presented with a petition for a franchise for the constructing of a continuation of the Converse Telephone Company's lines in that city. The board has taken the matter under advisement. The Converse Company is an Independent company which recently lost its connection with the United Company. Its lines extend from Converse as far west as Greentown and Kokomo.

The Fox River Valley Telephone Company, of Appleton, Wis., and the Valley Telephone & Telegraph Company, of Green Bay, Wis., have consolidated. Representatives present at the meeting when the consolidation took place state that the toll lines connecting all cities of the Fox River Valley and 45 other points in the eastern and northern parts of the State, with local exchanges at all points, will be in operation under one management by August 1.

A meeting of the Independent telephone men will soon be held at Ottawa, where they will have a hearing with the Canadian Government looking to the substitution of the Independent and probably Government owned lines there in opposition to the Bell interests in the Dominion.

The Volney Telephone Company, of Oswego County, N. Y., has been incorporated to operate a telephone system between Fulton and Volney. The directors are E. B. Tice, James Vant, J. S. Moss, Robert Simpson, Jr., Eugene Rowe, E. T. Hart and C. E. Sackett, of Volney.

With a capitalization of $20,000 the Weedsport, N. Y., Telephone Company has been incorporated by C. S. Caywood, N. F. Durston and George R. Nash, all of Weedsport.

The Springville, N. Y., Telephone Company has signed a contract with the Inter-Ocean Telephone & Telegraph Company for its long-distance telephone connections. This places the Springville company in the ranks of the Independents and affords it the advantages of excellent service. The Inter-Ocean's lines connect it directly with the Frontier Telephone Company of Buffalo, and with over 75,000 Independent telephone subscribers in Western New York.

A certificate of increase in the capital stock was lately filed at the county clerk's office by the Wayne-Monroe, N. Y., Telephone Company. At a meeting held in Williamson, the capital stock was raised from $100,000 to $200,000, divided into 1,000 shares of $100 each. At the meeting J. Seldon Brandt, of Ontario, was elected chairman, and Judson L. Transue, of Williamson, secretary.

In response to repeated demands from the Business Men's Association of Flushing, N. Y., the New York & New Jersey Telephone Company has promised to put all of its trunk lines and as many of the other lines as possible in conduits underground.

The Alachua, Fla., Telephone Company will soon commence the erection of the poles for a system for the town of Alachua, and will also handle a line to Gainesville and other points.

R. W. Wood has been appointed general manager of the Columbus, Ga., Automatic Telephone Company, succeeding A. G. Conoley, resigned.

A new telephone company has been organized at Faith, N. C., by H. C. Farmer, L. A. Raney, A. B. Goodman, J. H. Lyerley and J. B. McCombs.

The Wabash Valley Telephone Company of Effingham, Ill., will install a new plant, expending in the neighborhood of $16,000.

M. Durham will on August 1 succeed Mack Nelson as manager of the Independent Telephone Company, of Belton, Tex.

A new company, capitalized at $5,000, has been formed in Berwinsdale, Pa., known as the Clearfield & Cambria Telephone Company.

The Independent Telephone Company is putting in a new country line near Centropolis, Kan.

Over 350 new names appear in the new directory of the Iowa Telephone Company of Dubuque.

The Independent Telephone Company of Topeka, Kan., is installing new switchboards.

Telephone Incorporations.

The Commonwealth Telephone Company, Brooklyn, N. Y. Capital stock, $200,000. Incorporators: Edwin M. Brooks, Daniel Buhre, Brooklyn; John A. Crawford, Montclair, N J., and others.

The United Pay Station Telephone Company, Jersey City, N.J. Capital stock, $50,000. Incorporators: H. O. Coughlan, Thomas F. Barrett and J. W. Woods.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Alma, Kan.—The mayor and councilmen lately granted an electric light franchise to the Alma Light & Power Company, which is composed of W. B. Wilson, G. A. Mueller and others.

Creston, Ia.—The Creston Mutual Electric Light, Heat & Power Company has been incorporated with a capital stock of $50,000 by John Huckott and others.

Delta, Pa.—The plant of the Delta Electric Light Company, located along Muddy Creek, about two miles from here, has been purchased by the York, Furnace, Pequa & Lancaster Trolley Company. The purchase was made for the purpose of furnishing power for the proposed new trolley extension into York County.

Ephraim, Utah.—This city is to have its own electric light plant, and bonds for that purpose to the sum of $15,000 have been issued.

Glen Ridge, N. J.—The question of electric lights is being agitated here.

Homer, Ill.—The Homer Electric Light Company is considering a proposition to furnish lights in Fairmount.

Kenton, O.—The Kerlin Brothers Company, of Toledo, has purchased the plant of the Kenton Gas & Electric Light Company of this city.

Laramie, Wyo.—Alfred E. Kalter, of Indianapolis, has been granted a franchise to erect an electric light and power plant in this city.

Livingston, Mont.—J. E. Swindlehurst and Alexander Livingston have petitioned the city council for electric light franchises.

Magnolia, Miss.—The city has granted a franchise to J. H. Price, C. V. Ratcliffe and L. E. Schilling, to erect and operate an electric light and power plant.

Marianna, Fla.—At a recent election held here it was decided to bond this town to make certain improvements, among which was electric lights.

Mancelona, Mich.—The building and fixtures of the electric light plant lately burned to the ground. The loss is estimated at $5,000.

Menardville, Tex.—A company composed of local men has been organized here for the purpose of ginning, milling and electric lights, with a capital of $12,500. D. G. Benchoof, a merchant of this place, is president of the association, which will be incorporated under the name of the Citizens' Gin & Milling Company.

Oak Grove, Mich.—Steps have been taken for the erection of a power house and electric light plant here. It is expected that the building will be erected this season. W. G. Vinton has been appointed president, and William L. Smith vice-president, Dr. Burr, secretary, W. O. Smith, treasurer of the company formed to carry out the scheme.

Roswell, N. M.—This city will have a second electric light plant if the board of city aldermen grants the franchise asked by George F. Blashek, of this city. He asks for a 30 year franchise and guarantees that he will furnish lighting power at one-half the rate that is now being charged.

St. Louis, Mo.—The Retail Merchants' Association has decided to organize a company for the construction of another gas and electric plant in Bellville. President Fellner is to appoint a committee.

Tawas City, Mich.—The Thorne Electric Company has closed a contract with this city to install a complete municipal electric light plant.

Towner, N. D.—This place may secure an electric light plant.

Wamego, Kan.—A proposition is before the citizens to vote $9,000 for an electric light plant.

Walla Walla, Wash.—C. M. Maxwell and H. Day Hanford, of Seattle, have applied to the city council for a franchise for 25 years to establish and maintain an electric light and gas plant in this city.

Waverly, Pa.—By the bursting of a fly-wheel the borough lighting plant here was recently destroyed. The engines and dynamos were rendered useless. The loss is $50,000.

STREET RAILWAYS.

Bay City, Mich.—The city council has given a franchise to the old Bay City & Cairo Traction Company, which will build a second electric line from here to Saginaw.

Brooklyn, O.—A large number of property owners in Brooklyn, Parma and Middleburg Townships attended the meeting of the county commissioners lately, to advocate the granting of a franchise through their townships for an electric line. C. H. Hubbell has been securing their consents and is asking for the franchise.

Cohocton, N. Y.—It is believed that work will shortly be commenced on the electric railroad between Atlanta and Naples, for which a survey has lately been completed New York capitalists, who are represented by George H. Switzer, are behind the project, and the matter will now be carried before the State Railroad Commission.

Council Bluffs, Ia.—The promoters of the proposed electric line from this city to Griswold have organized temporarily with H. H. Van Brunt as president.

Hagerstown, Md.—The survey for the proposed electric railway to be constructed between this city and Waynesboro has been completed. Application will be made by the projector for the right to enter Waynesboro, and as soon as this is arranged work will be commenced on the road.

Iola, Kan.—The city council has granted a franchise to the Kansas Southern Electric Railroad Company to use the streets of this city.

Marion, O.—It is understood that the Columbus, Delaware & Marion Electric Railway is included in the Widener-Elkins consolidation of Ohio and Indiana trolley lines.

Monticello, Ia.—A movement is on foot by the business men of this city for the construction of an electric line from here to Davenport.

Nashville, Ind.—The town board has granted a franchise to the Ohio Valley Traction Company. The county commissioners will meet and give the company the right of way through Brown County.

New York City.—To make the change necessary to run its trains by electric power to the Grand Central Station, the New York, New Haven & Hartford Railroad Company is laying out a new terminal yard at Woodlawn. All the express and local trains will be run into the yard there and electric motors will haul them to 42d street at a rapid rate of speed. Between Woodlawn and Mount Vernon the double-track system is now being changed into a four-track line, so that a new rapid transit system will be instituted between that city and Manhattan to compete with the Harlem road.

Richmond, Va.—The Corporation Commission has chartered the Washington & Virginia Transit Company with a capital stock of $400,000. The president of the company is M. E. Church, of Falls Church, Va. Others interested in the company are Messrs. W. C. Pennywit, M. C. Mitchell, John B. Henderson, Jr , and Charles A. Kolb, of Alexandria. An electric railway will be constructed from Washington, D. C., through Fairfax, Loudoun and Fauquier counties by way of Aldie and Middleburg.

Sault Ste Marie, Mich.—It is proposed to build an electric line from this city to Cedarville, opposite Les Cheneaux Islands in Lake Huron, and connect with the Detroit & Mackinaw at Cheboygan by way of a ferry line.

Toledo, O.—Officials of the Lake Shore & Michigan Southern Railway say that the visit of W. K. Vanderbilt to this city recently was in regard to the advisability of installing an electric service on the Detroit & Toledo division of the line. It is said that Mr. Vanderbilt has decided the plan is feasible and that it will be put in operation at once. The initial steps in this plan will be confined to the freight business at first.—A new electric line from Jackson, Mich., to this city, is about to be built, and will be known as the Toledo & Jackson Electric Railway.

POWER PLANTS.

Ogdensburg, N. Y.—Electric power generated at Hannawa Falls, 38 miles distant, will be transmitted to this city under a contract signed between the Ogdensburg Power & Light Company and the Hannawa Falls Water Power Company. Transmission will be through aluminum cables. The power will be used for manufacturing purposes, operating the street railway and lighting the city. Thirty thousand hp. is available. Existing plants here will be retained as auxiliaries.

Pontiac, Mich.—The Clinton River Power Company was lately organized here with a capital stock of $75,000, of which $40,000 is paid in. The company will generate electricity at Amy by water power, and sell it in this city for commercial purposes. The plans ultimately contemplate the erection of three dams, which will develop 1,500 hp. This will supply current to all the nearby places and resorts.

BIDS WANTED.

Washington, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, until August 1, 1905, for the construction at the new Naval Hospital in this city, of a power house about 88 feet 6 inches long by 36 feet wide. Blank proposals will be furnished upon application to the Bureau. Address T. B. Harris, Paymaster General United States Navy.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15@15⅛c.; Lake 15@15¼c.; casting, 14¾@14⅞c.

The new securities of the New Orleans Railway Company will be ready for delivery on July 28.

There were produced by American makers in 1904 about 17,500 automobiles, valued at about $22,000,000.

A new street railway company in Philadelphia, with 3-cent fares, is said to be planned by some of the "reform crowd."

The Pittsburg Railways Company has bought the Beaver Valley (Pa.) Traction Company, owning 32 miles of track through the valley.

It is said that the gross earnings of the Philadelphia Rapid Transit Company for the year will amount to $16,400,000, an increase of $470,000 over last year.

The Long Island Railroad Company will begin the regular operation of electric trains on its Atlantic avenue division, Brooklyn, which is part subway and elevated, to-day.

The Hartford & Springfield Street Railway Company, which is managed and controlled by Tucker, Anthony & Co., has increased its capital stock by $200,000 of 6 per cent. preferred stock.

The Keystone Telephone Company has not issued its usual statement of earnings for the June quarter and it is stated that it has not as yet been determined whether reports will be made quarterly as before.

There is considerable strength and activity in Chicago Subway stock. Bullish "points" on the shares continue and a new high-record price, both in New York and on the Chicago Exchange, was established on Monday.

According to Chicago Union Traction interests no progress has been made in the negotiations with the city thus far. The latter appears to insist upon the company furnishing several sets of figures at which it would be willing to sell out.

The recent sale by the Brooklyn Rapid Transit Company of $2,500,000 four per cent. convertible bonds at 86 brings the amount of such bonds now outstanding to $19,500,000. It is probable that the bonds will be the last of the convertible class to be issued by the company.

There are many indications that a traction deal of large magnitude is under consideration in New York and that J. P. Morgan & Co. and Kuhn, Loeb & Co. will play an important part in the transaction. It is believed that the Morgan firm has been quietly picking up traction stocks, under cover, for some time.

It is reported that an important deal has been closed between the Philadelphia Electric Company and the Keystone Telephone Company. It is stated unofficially that the deal refers to the rental of the unused conduits of the telephone company to the Electric Company for a long term of years, which practically eliminates any possibility of competition in the electric lighting business.

The Twin City Rapid Transit Company's quarterly dividend of 1¼ per cent. on the common stock of the company will be payable on and after August 15, at the office of the Farmers' Loan & Trust Company, 16-22 William street, New York City. Dividend checks will be mailed to stockholders who have filed orders. The transfer books for the common stock will close at 3 P.M. on Tuesday, August 1, and will reopen at 10 A.M. on Wednesday, August 16.

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price July 24
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	205
Manhattan Elevated Railway	165½
Metropolitan Street Railway	126
Metropolitan Securities	81⅝
Ninth Avenue	197
Third Avenue	126⅜
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	68⅛
Brooklyn City Railway	239
New Orleans Railway	31
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	82
Philadelphia Traction	100
Union Traction	59⅞
Boston.	
Boston Elevated	157
Massachusetts Electric Companies, com	19
do. do. do. pref.	63
West End Street, com	98
do. do. do. pref.	114¼
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	8¼
do. do. pref.	33
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	15⅛
do. pref.	57½
Electric Boat, com	28
do. do. pref.	65
Electric Lead Reduction	
Electric Vehicle, com	18
do. do. pref.	27
Westinghouse, com	167½
do. pref.	194
General Electric	174
Boston.	
Edison Electric Illuminating	243
General Electric	174
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	160
National Carbon, com	63
do. do. pref.	118
Philadelphia.	
Electric Company of America	11⅛
Electric Storage Battery, com	81
do. do. do. pref.	81
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	138⅜
Western Telephone Company	18
New England Telephone Company	139
New York.	
American Telegraph & Cable Company	90½
Commercial Cable Company	210½
Mexican Telephone Company	1⅛
New York & New Jersey Telephone Company	179½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Otis Elevator Company	58
Consolidated Car Heating	64
Standard Underground Cable	

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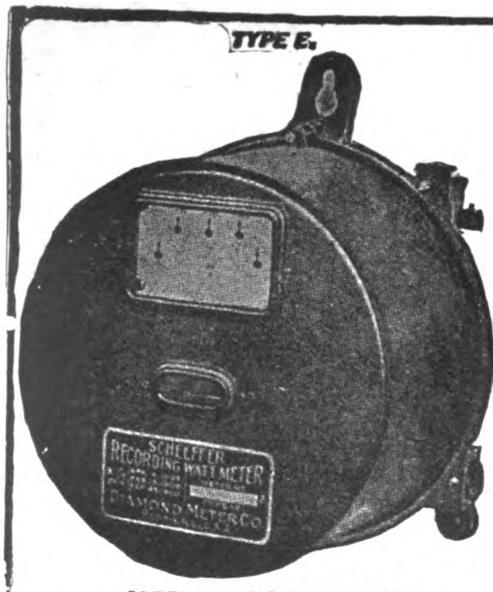

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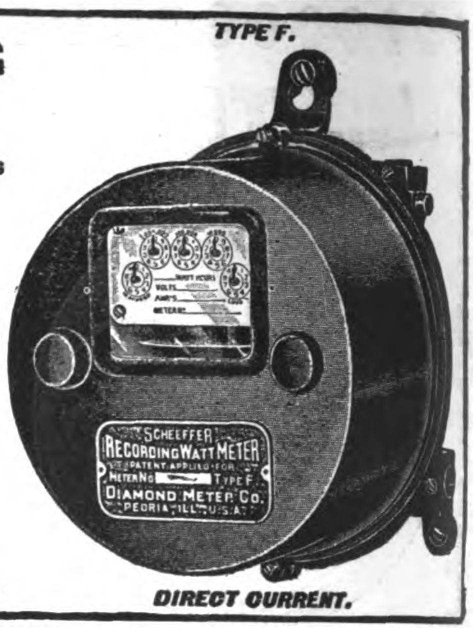

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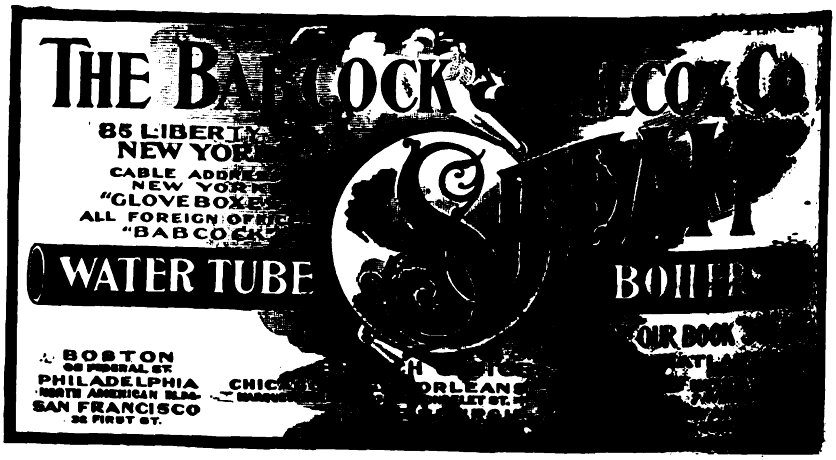

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ELECTRICITY.

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EDITORIAL NOTES.

The Risk of Exporting Copper.

The metals to which recourse can be had in case of necessity, in place of copper, are aluminum and iron. The three, therefore, represent the conductors used in electrical construction. Of the latter two only aluminum is of any practical importance, and its cross-section for equal currents would be double that of copper.

The risk of exporting copper from this country, in either a crude or manufactured form, becomes clearly evident when a review of the circumstances relating to the copper industry are presented. According to the record of our exportations of manufactured copper our sales have increased $25,000,000 in the last fiscal year. This means an enormous increase in the very items to which reference has been made, namely, manufactured copper goods. Returning to the proposition, however, it is easy to trace in outline the effects of the continued exportation of this doubly valuable metal, with regard to the public welfare and the individual private interests utilizing it. In this respect it may be stated that copper is the metal, in the United States, which in combination with the various forms of iron in use is wholly indispensable. The electric light interests, comprising the dynamo with its necessary windings on armature and field, and the wiring pertaining to such equipment, are but a single instance of the use of copper. The street railway interests are vaster in a sense than any other, and the enormous amounts of copper employed in their development comprise one of the heaviest demands upon the copper mining industry of which record has been made. It might be stated that the brass foundries consume enormous quantities of the copper alloy for ornamental and other uses; while this is true, the most useful application made of copper as a metal is unquestionably that for electrical purposes.

A shortage of copper would be a severe blow to the electrical industries of the United States. There is not so much copper to be had that the country is safe in exporting it, and it may be added, that there is no more in Europe than the people over there actually need, if enough. The grave problem this country may have to face some day, if too lavish in its sales of this precious and useful metal, will be the risk of industrial depression,

Copper, in the United States, is the most useful of all metals, as far as the science and practice of electric light, street railway and power is concerned. Intense joy over the heaviness of our copper exports is fundamentally and wholly out of place. Governmental supervision, in exercising discretion with regard to its exportation, will have its weight in the near future. Let us keep our copper.

* * *

Comparison of Electric Fields by Means of an Oscillating Electric Needle.

Mr. D. Owen recently read a paper on this subject before the London Physical Society. He described several experiments which showed how an electric needle may be used to measure electric fields in a manner similar to that in which a magnetic field is measured by an oscillating magnetic needle. The needles used were cylindrical in form, of aluminum or of brass, and were suspended by quartz fibres three or four inches in length. The couple on the needle when disturbed from the direction of the field is proportional to the square of the field strength. For small displacements the needle vibrates isochronously, the frequency being proportional to the electric force. It may be used in alternating as well as in steady fields, and may be applied to illustrate many of the laws of electrostatics.

The disturbing effect of the needle upon the field is considered; in particular its effect when placed in a uniform field. It was shown by experiments that the disturbing effect falls off rapidly with the distance from the needle, and is inappreciable (in the case of a needle 1½ cms. long) at a distance of twice the length of the needle. With regard to the effect of the dimensions of the needle upon the frequency (for given field), while the restoring couple decreases rapidly with decrease of size, yet the moment of inertia decreases more rapidly, so that the smaller the needle the greater the frequency and also the smaller the disturbing effect. The shielding effect of some dielectric materials was examined in the following way: A needle was suspended centrally in the uniform field between a pair of parallel plates. A thin-walled cylinder of the dielectric was placed around the needle, and the shielding action denoted by a fall in the frequency of the needle. Glass and mica were found to effect perfect shielding. Ordinary paper shields, but when thoroughly dried by heat the electric field is transmitted undiminished only to fall off to zero after a minute or two's exposure to the air. Dry paper soaked in melted paraffin-wax transmits the field perfectly and for an indefinite time.

The paper concluded by pointing out that an electric needle suspended between a pair of parallel plates forms a simple means of measuring high voltages, since the frequency of vibration is simply proportional to the voltage between the plates.

* * *

London's Traffic Problems.

The Royal Commission, which was appointed early in 1903 to investigate the problem of locomotion facilities in London, has at last issued the first section of its report. Briefly stated the Commission recommends the appointment by the Government of a traffic board to consider from time to time all measures which are promoted for new lines, surface and otherwise, and all matters arising in connection with locomotion development. The board will have to report annually, showing the progress made. Large extensions of electric tramway systems and the linking up of the at present disconnected lines of North and South London are recommended; local municipal bodies are to be deprived of the powers of veto which they have so disastrously exercised in recent years in preventing the laying down of new tramways by private companies. Many new electric tube and shallow subway railways are outlined as being necessary, and the tendency which has lately been witnessed for amalgamating various underground electric railways and surface trolley lines under one management is shown to be advantageous to the traveling public and in no sense otherwise. Beyond these proposals, and other suggestions for street widenings, etc., the engineering advisers of the Commission suggest as a scheme for consideration with a view to its adoption in years to come the establishment of two great main avenues from east to west and north to south at an estimated cost of $120,000,000. The report, however, urges that the various less sweeping proposals it has made shall not be shelved pending this main avenue scheme, which is regarded as a matter for the future and not for immediate execution.

It is probable that no new undertaking of serious importance will be promoted until Parliament has taken action upon this report. Whether it will be able to take such action before next year is extremely doubtful.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

A company is now being formed to acquire 19 of the leading street car building companies in the United States and organize a new company with a capital of $43,000,000. The consolidation embraces nearly all of the plants engaged in the building of street cars in this country.

◆

First Vice-President James Gayley of the United States Steel Corporation says the "recent great improvement in efficiency of electrical machinery and application for mines, and in long-distance transmission, makes it possible, it is believed, to substitute this power for steam at a vast saving in operating costs."

◆

According to the "Electrician," London, a Reuter telegram from Copenhagen states that the following mail advices, dated July 4, have been received there from Reykjavik: "An agent of Messrs. Siemens & Halske, the well-known Berlin electrical engineering company, is staying here at present. He has laid before the Althing a proposal on behalf of the company for the establishment of wireless telegraphic communication between Iceland and the Continent and between four commercial towns of the island, the company agreeing to provide the installation in return for a single payment of 660,000 kroner (about $183,330). The company offers to deposit a guarantee for the efficient working of the system. The yearly cost of maintenance is estimated at 50,000 kroner (about $13,885). An agent of the Marconi Company has also arrived here, and will submit to the Althing proposals for the installation of wireless telegraphy between Iceland and the Continent and between the four commercial towns of the island. The Marconi Company, it is added, has made experiments in wireless telegraphy from Cornwall to Iceland. These were successful on June 26, 28, 30 and July 3, but less so on other days."

◆

A cable dispatch from Berlin says the German scientific world is much interested in a discovery made by Herr Erfeurt, a chemist, who has succeeded in transmitting the qualities of radium to a substance he calls radiopher. Radiopher can be made cheaply. It is of great use in medical practice, for it can be injected under the skin and in other parts of the body. Herr Erfeurt claims that it possesses all the qualities of the original radium.

◆

A electrotechnical exhibition will be held at Kiev, Russia, in 1906.

◆

A peculiar result of subway travel in New York is that the Brooklyn Rapid Transit Company has carried 5,000,000 more fares in July this year than in the same month last year. Officials of the company explain this remarkable fact by saying it is now so much easier for residents of upper Manhattan and the Bronx to get to Brooklyn that more go to the seaside.

◆

Secretary Thomas R. Mercien of the Northwestern Electrical Association has been appointed by the Milwukee Bankruptcy Court, at the request of the Wisconsin Trust Company, one of the three appraisers of all the assets of the estate of Frank G. Bigelow, the bank president who was sent to prison.

◆

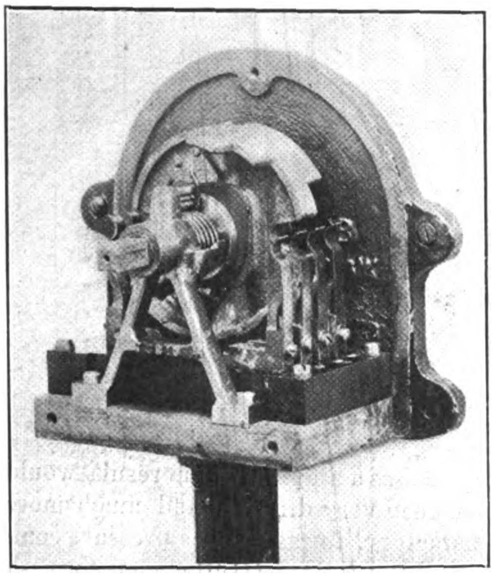
A foreign paper states that the number of passengers carried during 1904 on the Jungfrau railway in Switzerland was 58,036 against 57,167 in 1903. The densest traffic occurred in July and August, in which months the number of passengers was 17,566 and 25,406 respectively.

NEW TRAIN CONTROL FOR BROOKLYN ELEVATED TRAINS.

BY RAY HAMILTON.

When the Brooklyn Rapid Transit Company completed the task of electrifying all the elevated lines operated by them, it became necessary to replace or reconstruct all the rolling stock that had been used in connection with the steam service.

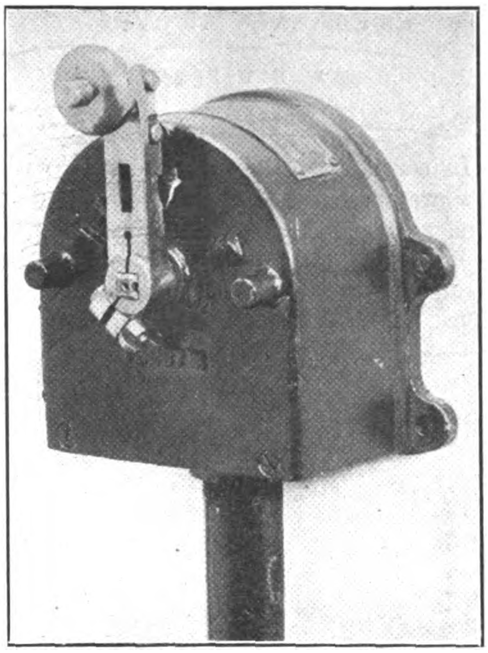
This was accomplished by rebuilding most of the cars at their 39th street repair shops and over 400 cars have been overhauled and equipped with up-to-date electrical devices. The rapidity with which this making-over process has been done has not lessened to any appreciable extent the congestion and the increase in traffic has been so great that a large number of other cars are even now required, notwithstanding the fact that the company foreseeing these very conditions, ordered 100 new semi-convertible cars in 1903.



Interior View of Master Controller.

These cars were delivered six or eight months ago and nearly all of them have been equipped with motors, air brakes and controls, and are now in regular service. The new cars are to all appearances similar to those now in use on the Manhattan Elevated, but closer inspection reveals many features of interest that are not found in the latter, as for instance the semi-convertible arrangement, so that the car may be a closed one or approximately an open one, according to the state of the weather; the underframing is another example of recent improvement in car design, and this construction not only eliminates the usual truss rods, but secures perfect alignment as well.

The platforms are arranged with lifting trap doors and are also provided with steps, so that the cars may be run on either elevated or surface lines. It is essential in this case for the lines that connect Brooklyn Bridge with Coney Island and other seaside resorts are made up of elevated and surface railways, the last named having been formerly operated by steam.



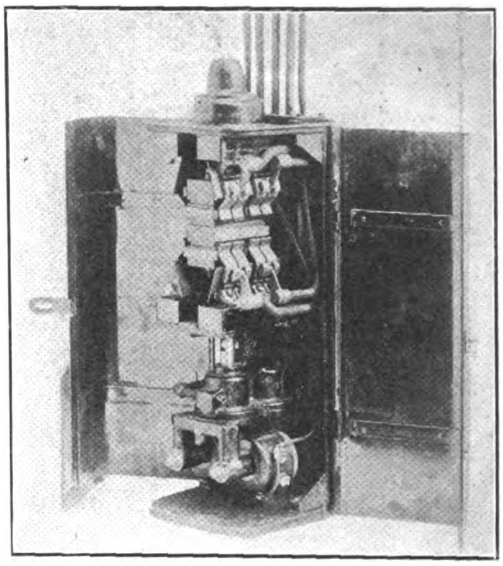
Exterior View of Master Controller.

The underrigging of the new cars is especially noteworthy, for it includes a new and novel electropneumatic system of controlling trains. It is understood, of course, that where a number of motor cars are made up in a single train the motors of all must be controlled from some given point, i.e., the front end or cab of the first car, and that this may be successfully done from the standpoints of both economy and safety is the purpose of the new device. Compressed air is utilized for performing the movements of the controlling apparatus and this is obtained from the air brakes and works under a pressure of 70 pounds per square inch.

The controller comprises 13 main motor switches and each of these has its own air cylinder and interlocking device similar in construction to those used in electropneumatic signaling. Each switch is also provided with a powerful spring so that the former has a normal tendency to remain open, but when the cylinders are charged with air the applied pressure causes the switches to close. To throw the switches, all that is needed is to cut off the air and the sparking that results on breaking the contact is reduced to a minimum by means of a magnetic blowout.

The valves of the air cylinders are operated electrically by electromagnets that are energized by a current derived from a small battery of storage cells giving 14 volts, suspended from the panel of the car. There are two of these batteries, and while one is in use the other is charging. These batteries are charged from the circuit of the main line, the current being cut down either by a bank of lamps or by a compressor motor.

The electromagnets operating the valves are governed by a small master controller, the detailed construction of which is shown in the illustrations. When all the circuits are broken, the handle of the controller is in a vertical position. When the handle is turned toward the right, the motors drive the car forward, and turned toward the left, the car travels backward. There are three right and three left-handed notches; the handle placed on the first notch brings the reverser into proper position, the circuit breaker is then closed, and the motors of each car are connected in series with all the resistance in circuit.

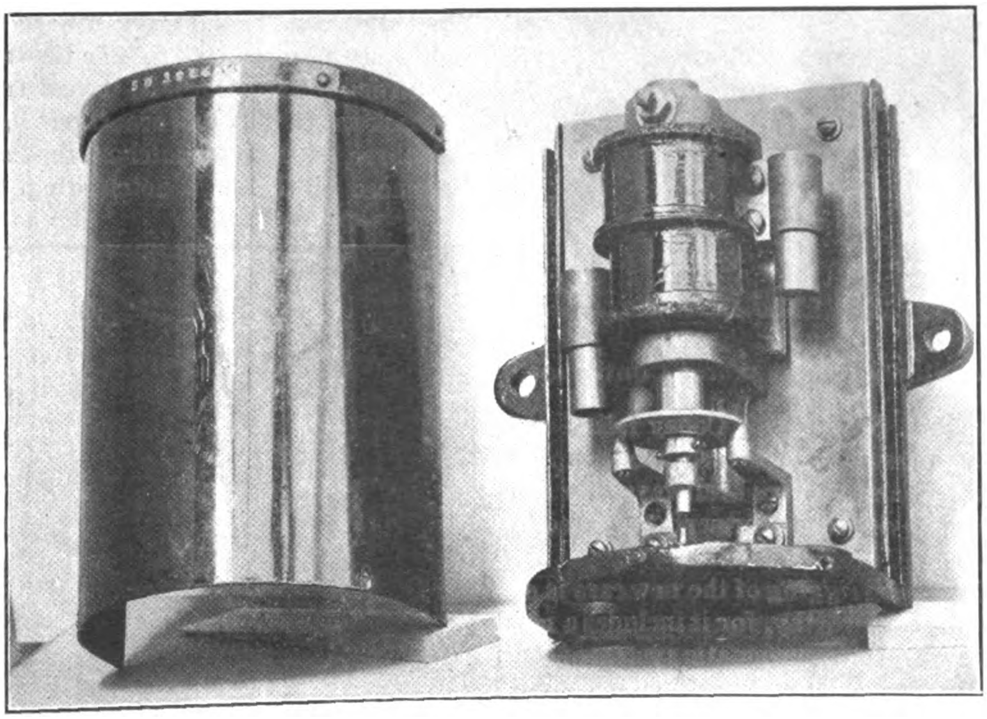


Reverser Used in the Control System

When the handle reaches the second notch, the resistance is gradually cut out, so that the motors are soon running without any artificial resistance in circuit. When the handle is turned to the third notch, the motors are connected in multiple, and the resistance is now in series, which as the motors increase in speed is finally cut out.

The handle when resting on either the second or the third notches of the master controller connects the motors in multiple or in series without resistance, though the amount of resistance is governed automatically by the current the motors take. Two coils, one for operating and one for holding, are associated with each electropneumatic valve. The holding coil, as it is termed, is designed to hold the switch in its proper place after it has been closed by the operating coil.

When one of the electropneumatic valves is set in action by the current flowing through the operating coil, the valve closes its complementary switch in the main current by turning air into the cylinders. The instant the main switch is closed, the holding coil of its electromagnetic valve is thrown into action, and the switch is held closed regardless of the action of the limit switch. The object of the limit switch is to protect the motors from currents greater than they are designed to stand should these flow through the circuit; the limit switch does this by preventing the operating coil from closing the principal switch, but when the current is of normal value, the switches are closed in sequence by the operating coils.



The Limit Switch of the Unit Switch Group Control.

One of the features of the unit train control system is the design of the electric switch pneumatic cylinders. Interlocking contacts are now included in their construction and the contact arms are provided with a long elastic spring to which it is hinged, so that in closing the switch the former is compressed. The contact wiping action of the hinged arm on the spring keeps the contacts clean, while the use of a special soapstone cell keeps them cool.

The limit switches of recent make have contacts of solid platinum and this renders its use absolutely certain. The reverser and air valves are placed in protecting cases, and the whole system is much more simple and compact than those heretofore used, the first item being of importance in its operation, and the second in its maintenance.

EMERGENCY VALVES.

BY W. H. WAKEMAN.

ARTICLE I.

In small steam plants operated with low pressures, where the piston speed is moderate and the travel of flywheel rim well within safe limits, especially if only one boiler is used, there is no great necessity for the emergency valves described in these articles, but where steam at high pressures is used to drive pistons at from 600 to 1,000 feet per minute, bringing the rim speed of flywheels dangerously near the breaking limit, the case is very different, because if an accident does happen, the consequences are liable to be much worse if the engineer cannot control the flow of steam instantly, than where emergency valves are installed and kept in good working order, ready for whatever may happen to bring them into operation.

For illustration of this suppose that we take a plant comprising six boilers of 150 hp. each. On account of some hidden defect, or perhaps to lack of proper care, a tube in one of these boilers fails, filling the room with hot water and steam, making it dangerous to go on top of the disabled boiler to shut the stop valve, which consists of a common globe, angle, or gate valve.

In this connection it is well to remember that if a man draws in one full breath of steam, it is sufficient to cause much suffering and perhaps death.

Under above conditions it is impractical to isolate this boiler from the header into which five others are discharging steam, consequently all that can be done is to bank the fires and let all of the steam escape, which is almost sure to damage the building and cannot fail to cause expensive delay of the works.

If the valve shown in Fig. 1 had been installed as a stop valve the result would have been very different and much more satisfactory, for as soon as pressure commenced to fall, causing steam to rush from the header back into this boiler, the emergency valve, which is now open, would have closed instantly, acting as a huge check valve.

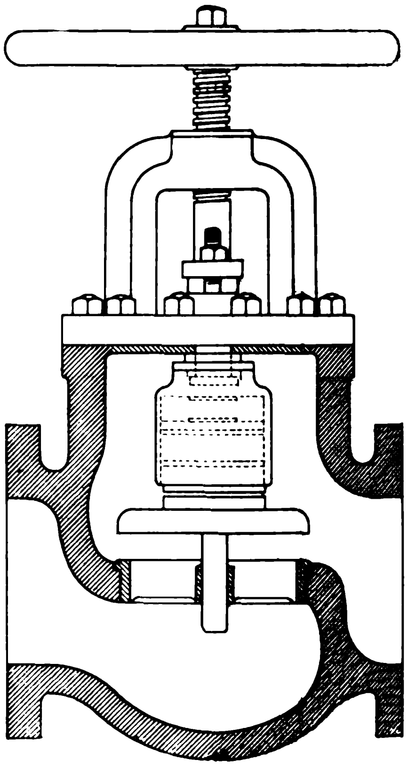


Fig. 1.

Steam and hot water contained in the disabled boiler must of necessity come out into the room but would not disable the whole plant. When one fire was banked the other boilers would continue in operation as if an accident had not happened.

This valve is fitted with a cylinder and plunger as shown, forming a dash-pot, which prevents violent closing of the valve under previously mentioned conditions.

In a certain plant where 20 boilers were arranged in two batteries the following practice prevailed: When one or more of these boilers were cleaned and filled with cold water, steam from the others would be turned into these, heating the upper part of shells but leaving the lower portion cold.

In addition to this unnecessary strain on the parts there was much danger of water hammer striking blows with great force, thus straining the boilers more than their regular working pressure.

With valves like that described or the kind illustrated in Fig. 2 such dangerous practice is impossible. This valve is now closed but when at work under normal conditions steam comes up through the passage 2 and passes out at 3 to the main header, opening the valve 4. A dash-pot is shown at 5 in which a plunger works, and as the stem of valve 4 is screwed into the plunger it prevents too violent action of the valve.

So long as the pressure at 2 is slightly above that at 3 the valve 4 is held open, but when these conditions are reversed the valve closes instantly.

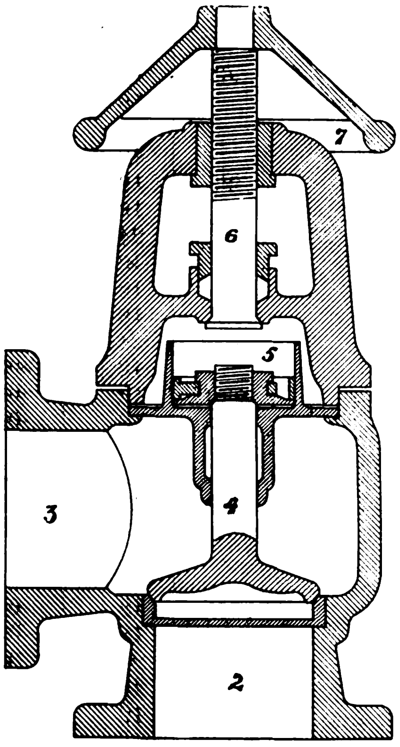


Fig. 2.

From this description it will be plain that if the boiler to which this valve is attached is laid off to be cleaned, no steam can be blown into it even if it is desired to do so as there is no way provided for overcoming the header pressure and opening the valve. The stem 6 may be screwed down by means of the hand wheel 7, but that only holds the valve shut. As a matter of interest I will state that the chief engineer of the plant mentioned did not approve of this dangerous practice, but this was one of those mismanaged places where the chief engineer neither hired or discharged assistants and firemen, consequently he could not control their actions. Boilers were frequently filled with cold water at night when the chief was not on duty.

A boiler ought to be heated gradually until the pressure equals that in the others, then the stop valve should be carefully opened, connecting all into a battery. With these valves in use, this action is performed automatically, without attention from anybody, insuring safety along this line.

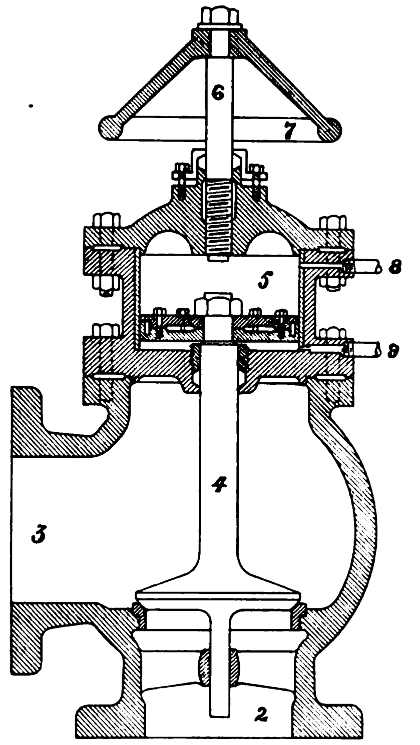


Fig. 3.

Other accidents to be guarded against are those which cause a sudden and violent rush of steam from the boilers into the heater. This can be caused by bursting of the main steam pipe, due to unprovided-for expansion, or hidden defects in pipes or fittings. When a governor belt breaks or runs off from the pulleys which carry it, matters assume an interesting aspect at once unless a safety device of some kind comes to the rescue.

The throttle valve of an engine is usually located in line with the swiftly revolving wheel, making it necessary for the engineer to assume an extremely dangerous position if he attempts to shut off steam and save his engine from destruction.

If a valve is provided in the steam pipe or in each boiler, which may be instantly closed from a safe place, a bad wreck may be prevented.

A valve of this kind is illustrated in Fig. 3 and is operated as follows: Under normal conditions steam comes up through 2 and passes out at 3, raising the valve 4, which carries a piston in the cylinder 5. The stem 6 is unscrewed by means of the hand wheel 7, so that it does not interfere with the valve stem below it unless it is desired to close the valve by hand; 8 is a pipe for admitting steam at boiler pressure, and 9 allows any which may leak past the piston to escape into the atmosphere, thus preventing back pressure on the piston.

A one-half inch pipe is tapped into the upper part of a shell, or into the main steam pipe below the emergency valve. This is carried to some convenient and safe place, where a globe valve is fitted to it, after which the pipe is continued to the emergency valve and connected into 8. If at any time it is desired to shut off steam from the boiler, this one-half inch valve is opened and instantly the flow of steam is stopped. It will be noted that this action does not depend on the direction in which steam is flowing, nor yet upon any slight variation in pressure.

With a battery of six boilers fitted with these positive closing valves, it is necessary to have six small valves. They should be located on a valve board and numbered as shown in Fig. 4.

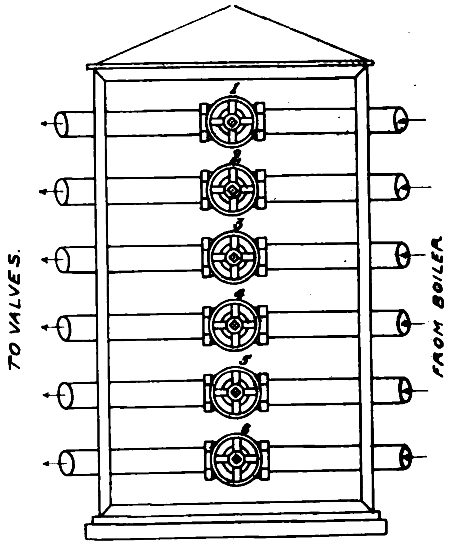


Fig. 4.

In view of the fact that accidents to steam pipes are frequently reported in the mechanical papers, and in some cases much less trouble and damage would have resulted had it been possible to shut off steam at once, the necessity of providing means whereby the stop valves of a plant may be quickly and safely closed must be apparent to everybody interested.

Electrifying China.

As the completion of the electric tramway draws near the rumors among ignorant natives grow apace. The latest is that 500 Chinese heads must be procured and buried under the power house before the "kreta hantu" can start running. In consequence of this rikisha coolies refuse to take fares into the country districts at night.—Singapore "Free Press."

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

THE TRANSMISSION OF POWER.

Capacity and Inductance in Power Lines.—Great power plants are connected with the points of distribution by transmission lines. These line are affected in two respects—first, the electrostatic effect of one upon the other and of each upon the earth; second, the electromagnetic effect of self and mutual inductance. The two effects may be entitled, the inductance and the capacity of the line.

Non-Inductive Circuits.—The conditions which make a circuit inductive or non-inductive may be regarded as those which individually or collectively add more or less of a varying magnetic field to the circuit. For instance, a core of iron around which a coil of wire carrying an alternating current is wound is an extreme case of inductance. The removal of the iron core reduces the degree of inductance, and the straightening of the wire from its coiled form still further reduces it. When two straight wires are employed for the purpose of transmitting electrical energy in the form of an alternating current, they have the least effect inductively upon each other when closest together. In other words, if one wire leading out, and the other leading back to the power house, are installed a short distance away from each other, the effects of self-induction are less than when they are widely separated, but a wide separation between high tension wires is relatively necessary as insulation could not otherwise be secured, particularly during conditions of great dampness or severe rain. The distance between copper conductors will influence the degree of inductance to an extent indicated by the following figures: For a No. 0 B. & S. gauge pair of wires, run parallel and at the distances of 12, 18, 24 and 48 inches apart, the inductances in each case will be respectively .00254, .00276, .00293 and .00331 henrys. A line is necessarily possessed of a certain amount of induction, which in the estimate of its true carrying capacity calls for consideration. It is quite evident that the increasing value of high potentials necessitates the use of greater distances between power lines than would be otherwise necessary. Tests have been made for the purpose of determining the pressure, and distance over which spontaneous sparking would result. The results have been tabulated in a case where a wave form of current was employed with the spark leaping between needle points. A chart with a curve showing the relationship between the distance and pressure with corresponding data is given. The diagrammatic and tabular form in which these facts are given will give some idea of the conditions resulting from the use of high pressures when the questions of inductance and insulation arise:

SPARKING DISTANCES IN AIR FOR GIVEN PRESSURES.

Volts.	Inches.	Volts.	Inches.
5,000	0.225	60,000	4.65
10,000	0.49	70,000	5.85
15,000	0.725	80,000	7.10
20,000	1.000	90,000	8.35
25,000	1.300	100,000	9.60
30,000	1.625	110,000	10.75
35,000	2.000	120,000	11.85
40,000	2.45	130,000	12.95
45,000	2.95	140,000	13.95
50,000	3.55	150,000	15.00

According to these figures, the tendency to reach and pass 100,000 volts for power transmission will mean a distance between conductors exceeding 10 inches. In fact, for the sake of safety, it would have to be considerably greater. High voltages like these are employed in insulation testing, where what is called a breakdown test is made to discover the pressure necessary to puncture the insulating material.

Calculating the Inductance Between Wires.—Various tests may be made to ascertain the amount of inductance between two parallel wires of copper or aluminum by employing a galvanometer and measuring the results obtained. On the other hand, fairly accurate calculations can be made by selecting and using a reliable and simple formula for the same purpose. A formula of this character is given in which

A = distance between the wires in inches,
d = diameter of the wires in inches,
L = the inductance in henrys,

then the total inductance per mile of circuit is found by means of logarithms in the following formula:

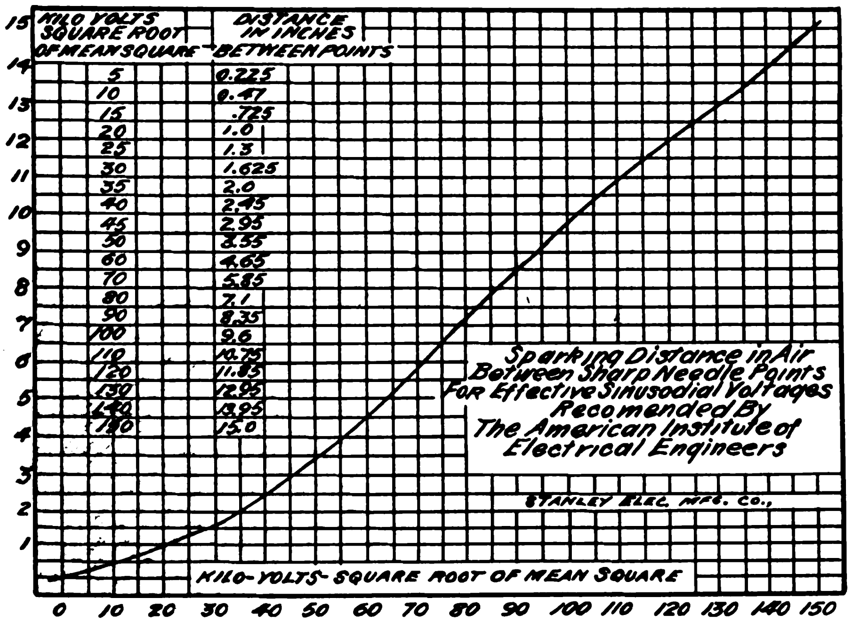
$$L = .000558\ [2.303 \text{ log. } \left(\frac{2A}{d}\right) + .25]$$

The logarithm of $\frac{2\,A}{d}$ is a very simple matter to obtain by the ordinary student of arithmetic. A book of logarithms will contain directions for getting results by their use, a matter that can hardly be treated in this article. A table can be built up based upon this formula, in which the inductance is calculated for various distances between wires of different diameters. A table of this character, which will prove serviceable in forming preliminary estimates of results in this respect, in lines about to be constructed, is hereby given:

INDUCTANCE PER MILE OF CIRCUIT.

Size B. & S. Gauge.	Diameter of wire in inches.	Distance between wires in inches.	Self-inductance in Henrys.
0000	.46	12	.00234
		18	.00256
		24	.00270
		48	.00312
000	.41	12	.00241
		18	.00262
		24	.00277
		48	.00318
00	.365	12	.00248
		18	.00269
		24	.00285
		48	.00330
0	.325	12	.00254
		18	.00276
		24	.00293
		48	.00331
1	.289	12	.00260
		18	.00281
		24	.00308
		48	.00338
2	.258	12	.00267
		18	.00288
		24	.00304
		48	.00314
3	.229	12	.00274
		18	.00290
		24	.00310
		48	.00351
4	.204	12	.00280
		18	.00300
		24	.00315
		48	.00358
5	.182	12	.00280
		18	.00300
		24	.00315
		48	.00358
6	.162	12	.00291
		18	.00313
		24	.00329
		48	.00369
7	.144	12	.00298
		18	.00310
		24	.00336
		48	.00377
8	.128	12	.00303
		18	.00325
		24	.00341
		48	.00384
9	.114	12	.00310
		18	.00332
		24	.00348
		48	.00389
10	.102	12	.00318
		18	.00340
		24	.00355
		48	.00396

The influence of inductance is annihilated by the use of concentric conductors or by conductors twisted around each other. The effects of inductance unless remedied are noticeable in the increased impedance in the line and the lag of the current. The nearness of the conductors in pairs is detrimental in that it causes an increased mutual induction between them. To overcome this difficulty, it is necessary to make use of the method of transposition in installing the wires. This consists of the crossing of the conductors at certain intervals so that a neighboring pair of wires remain inductively unaffected by the variations occurring in the first pair. In the diagram are shown instances of transposition and the effects of the same as shown by arrow heads. In the case presented neutralization will result because the transposition occurs at the middle of the lower line and its effect therefore is nil with respect to the neighboring line. The other cases are developed so that a constant transposition is indicated in the diagram. In the case of 20 wires, as illustrated, the upper and lower cross-arms of a pole line are shown with a series of transpositions systematically occurring, as the upper diagram is intended to represent. The entire process is merely the application of the first original idea, logically carried out.



KILO VOLTS SQUARE ROOT OF MEAN SQUARE	DISTANCE IN INCHES BETWEEN POINTS
5	0.225
10	0.47
15	.725
20	1.0
25	1.3
30	1.625
35	2.0
40	2.45
45	2.95
50	3.55
60	4.65
70	5.85
80	7.1
90	8.35
100	9.6
110	10.75
120	11.85
130	12.95
140	13.95
150	15.0

High Voltage Curve.

Capacity of Lines.—The static capacity of transmission lines can be calculated by formulas covering such cases as arise due to the use of insulated lead-covered cables, single conductors with a ground return, or two parallel conductors constituting the total circuit. In the first case the formula give the capacity in microfarads per mile for lead-covered cables:

$$C = \frac{38.83 \times K \times 10^{3}}{\log. \frac{D}{d}} \text{ per mile}$$

For a semi-metallic circuit with ground return:

$$C = \frac{38.83 \times K \times 10^{-3}}{\log. \frac{4h}{d}} \text{ per mile,}$$

and for conductors running parallel to each other:

$$C = \frac{19.42 \times 10^{-3}}{\log. \frac{2A}{d}} \text{ per mile.}$$

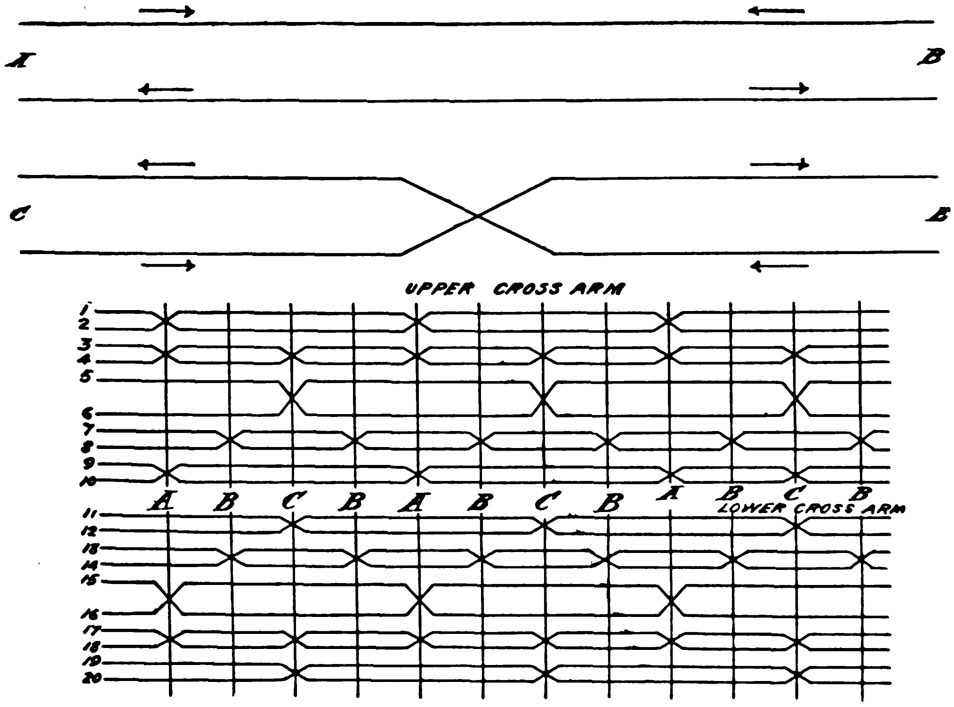
where C = microfarads.
K = specific inductive capacity of insulation.
D = inner diameter of lead covering of cable.
d = diameter of conductor.
h = height of conductor above ground.
A = distance between wires.

The capacity of a circuit may be controlled as far as its effects are concerned by the introduction of a certain amount of inductance. By this means a neutralization of one by the other is effected successfully. The relationship of the two must be such that $C = 1 : (2 \times \pi \times f)^2 \times L$, in which f = the frequency and L = henrys. It is obvious that a knowledge of the capacity of mile lengths of three-phase circuits, with the wires at different distances apart, will be extremely valuable in calculating the degree of inductance necessary to clear the conductors of all interference. In the following table the capacity of the microfarads per mile of circuit is given for a three-phase system:

MICROFARADS PER MILE LENGTH OF CONDUCTORS OF A THREE-PHASE SYSTEM.

Size of wire.	Diameter of wire.	Distance between conductors	Microfarads capacity.
0000	.46	12	.0226
		18	.0204
		24	.01922
		48	.01474
000	.41	12	.0218
		18	.01992
		24	.01876
		48	.01638
00	.365	12	.0124
		18	.01946
		24	.01832
		48	.01604
0	.325	12	.02078
		18	.01898
		24	.01642
		48	.01570
1	.289	12	.02022
		18	.01952
		24	.01748
		48	.0154
2	.258	12	.01972
		18	.01818
		24	.01710
		48	.01510
3	.229	12	.01938
		18	.01766
		24	.01672
		48	.01480
4	.204	12	.01874
		18	.01726
		24	.01636
		48	.01452
5	.182	12	.01830
		18	.01690
		24	.01602
		48	.01426
6	.162	12	.01788
		18	.01654
		24	.01560
		48	.0140
7	.144	12	.01746
		18	.01618
		24	.01538
		48	.01374
8	.128	12	.01708
		18	.01586
		24	.01508
		48	.01350
9	.114	12	.01660
		18	.01552
		24	.01478
		48	.01326
10	.102	12	.01636
		18	01522
		24	.01452
		48	.01304

Conductors Carrying Power.—Conductors for carrying power can only be properly estimated on the basis of their weight, strength, temperature, resistance, capacity and inductance. The determination of these elements will lead to the correct commercial estimate of their cost. At its best, power transmission is a financial question involving certain expenditure and returns. The degree of intelligence shown in the laying out of a power transmission system is therefore subordinate to the financial condition involved. It must be applied, so that co-operation of one with the other will lead to the evolution of a paying equipment.



Effective Transposition.

FREE SIGNS AND FLAT RATES.*

BY C. W. LEE.

Publicity is the commercial watchword of to-day. Through divers channels millions of dollars are annually being poured in an effort to reach the buying public. That these efforts are productive of results cannot be gainsaid. The various methods followed in the outlay of this vast expenditure can be summed up in one word—advertising.

By the united efforts of publisher and advertising agent the merchant and manufacturer have been educated into spending a certain percentage of their gross income for publicity. Lighting companies should be deeply interested in and be an aid to the development of this wonderful field of advertising, because of the outlet it offers for the sale of current, which they can readily produce after the present peak hour.

While it is my desire to consider only one phase of the advertising subject—that which relates to the possibilities presented in the use of electric signs as a means of obtaining long-hour customers—yet the entire field when properly developed, as it can be, means an added stimulus to window lighting and closely in its wake will come increased store lighting.

In the development of electric lighting numerous new difficulties are constantly being presented, while but few of the old ones have been left behind. Of these accumulated troubles the majority, in one way or another, apply to that bugbear of all lighting companies, the peak-hour. Try as we may none of us has succeeded in persuading one-half of the public to use current during the day while the other half uses it at night. True, the development of the electric motor and the invention of numerous current-using devices have had a direct bearing upon making the station load more uniform, but at best they have only helped out during daylight, leaving the hours of darkness still to be taken care of.

As it is impossible to induce the use of current when it is not needed, and as we are now supplying the present wants of our customers, it remains for the central station managers to discover new needs and educate the public to accept them. Current for illuminating purposes does not present the proper outlet, for this business is already ours, but the great field of advertising with its limitless possibilities offers many attractions. Here is long-hour burning with the hardest of the missionary work already done. The manufacturer and the merchant are ready and willing to spend money for advertising, but the lighting companies, with a few exceptions, are receiving but an infinitesimal share of the appropriations.

Neither the great general advertiser nor the small storekeeper should be overlooked in an aggressive sign campaign; one has billboards to illuminate, the other a store front. By the introduction of aggressive methods electric companies can fill the night world with light. Why not seize upon this field? Tackle it with vigor. Give signs away, or, rather, loan them to your customers. Don't use half-hearted methods and try to sell them because of the fear of possible losses in the lending. Changeable and interchangeable signs are cheap and by their universal use you can absolutely prevent losses.

I am familiar with the methods of a lighting company, covering a well-populated but scattered territory, which at the beginning of 1904 had less than 50 signs connected. This company adopted the free sign proposition, gave way two standard types of signs, both of which were changeable, and at the beginning of 1905 had over 450 connected, containing a total of 29,749 4-cp. lamps, returning an annual revenue of $59,130.48. This company charged off the first year the cost of constructing signs of changeable letters, as well as all erecting and connecting cost, together with 20 per cent. depreciation on the sign, 5 per cent. depreciation on station, line, meter and transformer investment. Charging the current used at cost, with lamp renewals and maintenance, it earned from 10 to 50 per cent. on the investment for each sign and its pro rata station and line cost.

Many of these signs are now on their second year's burning. This year's profits will be much greater, because all construction, wiring and erection items were charged against the first year. A few customers were lost at the expiration of their first contract, several failed or died after using their signs for only a few months, but those months paid part of the cost of erection, and all signs were immediately installed elsewhere. Signs were put up on one-year contracts, current sold at rates averaging over 10 cents per kilowatt hour, and to insure a proper use a monthly minimum was required equal to about 1½ hours' daily burning. This is not the only company that has worked for its share of the sign business. However, its experience is typical, and the plan succeeded because the promotors had faith in signs and made it easy for its customers to obtain them.

With a view to further increasing the sign business this same company has recently placed in operation a plan whereby the greater portion of its sign lighting will be entirely removed from its peak during the months when the peak must be considered. Free signs on a flat rate for certain stipulated hours each night is the nucleus of this plan. The time of switching on is placed about half an hour after the peak load. The turning on and off of signs is controlled by patrolmen, who not only attend to these duties but inspect all signs as well as solicit new business. It is expected that as soon as this plan is under full headway, the increased business will necessitate the running of special sign circuits from the station. In this event the expense of patrolmen would be eliminated. Isolated signs at some distance from the main streets are controlled by time switches.

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*Paper read before the National Electric Light Association at its 28th convention, held at Denver-Colorado-Springs, Col. June 6-11,

The flat rates adopted are based upon current for the first two hours each night at regular rates and at a low rate for every hour's burning thereafter. Customers are thus induced to continue long-hour burning.

The meter has been a formidable obstacle in the upbuilding of the sign business. In most cities and towns the early closing movement is in vogue and this makes the flat rate welcome, as many merchants are obliged to leave their signs and windows in darkness rather than go to the expense of employing a watchman to cut their lights out at a certain hour.

The flat rate has a particularly good effect on sign lighting as it insures use of the sign six or seven nights a week, while those operated on a meter basis are used only the nights when the store is open, which is the time when we already have large demands for our current.

Before the adoption of this flat rate schedule it was argued that no customer would be willing to contract for a sign that could not be turned on during the first half-hour of darkness, but experience has proven that this question is waived in many instances, the specific rate overshadowing this point. To the customer who desires the other method the meter is always available. Again, this flat rate has been the means of stimulating a large amount of sign business away from the heart of the retail district. It finds favor with the neighborhood stores and with business places on the back streets. Further, it has demonstrated the fact that an electric sign as an advertising medium is a pronounced stimulus to trade in the outlying districts.

If the flat rate is feasible for sign lighting why not apply it to window lighting as well. As the hour of closing comes the average merchant turns the key in the door and leaves his entire store in darkness, the very best advertising hours for his wares being thereby lost. If he could be assured of a specific rate per month for the lighting of his display, would not such a rate be an inducement to have lighted windows until 10, 11 or 12 o'clock each night? Sunday window lighting could also be induced by this method. It is strange that so many merchants allow this, the best advertising day in the week, to slip by without taking advantage of it. On Sunday evenings, while waiting for cars or strolling for pleasure, people have more opportunity to inspect windows than at other times.

ILLUMINATED BILLBOARDS.

By the large national advertisers, billboards and sign boards are now classed with the newspapers and magazines as strong mediums for reaching the public purse. The latter can be read during both daylight and night hours, but not so the billboard. Its usefulness ceases as soon as the sun goes down. It is through the medium of the lighting companies of the country that these billboards can be made to tell their story by night as well as by day. In treating this subject in a general way I am fully aware that in a few metropolitan centers illuminated billboards are maintained to a limited extent.

Recently, in conversation with one of the members of a large bill-posting company, I discovered a decided leaning toward the illuminated billboard. There is no question but that the National Bill-Posters' Association would welcome a plan whereby the efficiency of advertising space could be made more valuable. In the past they have fought rather shy of this matter, owing to the great difference in the lighting rates prevailing over the country. If there were some means whereby this association could meet the National Bill-Poster's Association on a fair footing, establishing a uniform lighting rate for the entire country (by that I do not necessarily mean a low rate) I believe that it would be the means of producing a splendid volume of new business in which all lighting companies would eventually participate.

Advertising appropriations are usually distributed through advertising agencies. Experts plan the campaigns with the expectation of obtaining certain results. Various mediums are used, according to the product to be sold. For their services the bill-posting companies charge a specific amount per foot for painting, a specific amount for position and a specific rate per sheet for posting. This rate is uniform throughout the United states. All of the details of illuminated billboards would fall upon the bill-posting company; maintenance, posting and collections. It would then only rest with the lighting companies to furnish current at a uniform rate.

For instance, should the American Cereal Company, manufacturer of Quaker Oats, desire to cover the State of Colorado with an illuminated billboard campaign, it would only be necessary to place the order with the Denver Bill-Posting Company for, say, 300 boards. They would be able to quote at once a specific price for this service, and could guarantee location, posting and illumination, knowing the prevailing rate for lighting.

I believe that this plan is worthy of consideration by this association. The advertiser is seeking novelties, he has the money to spend and it only remains for the lighting companies to come forward with a plan to be able to secure their share of the advertising appropriations.

WRINKLES.*

EDITED BY H. C. ABELL.

Synchronous Motors as Alternating Current Generators.

At Montgomery, Ala., four direct current, 500-volt generators are operated by synchronous motors, which are driven by the current from a water-power plant 30 miles away. The motors and direct current generators are so arranged that they can be operated by steam engines in case of any trouble or any shut-down at the hydraulic station. The synchronous motors are then driven by the engines, and become alternating current generators, furnishing the alternating current.

W. WHEELER, Montgomery, Ala.

Setting Line Poles in Concrete.

Where line poles are to be set in concrete, use cinders about 1 inch in diameter in place of stone in making the concrete. This is cheaper than cracked stone, where station is run by steam power, is sufficiently strong to make a good setting and is much more easily broken out than concrete made with stone when the pole has to be reset or removed.

P. C. BROWN,
Brookline, Mass.

A Quick Method of Planting Poles.

In constructing the transmission line from Montgomery to Tallassee, Ala., it was necessary to erect over 1,500 poles, varying from 85 to 65 feet in length.

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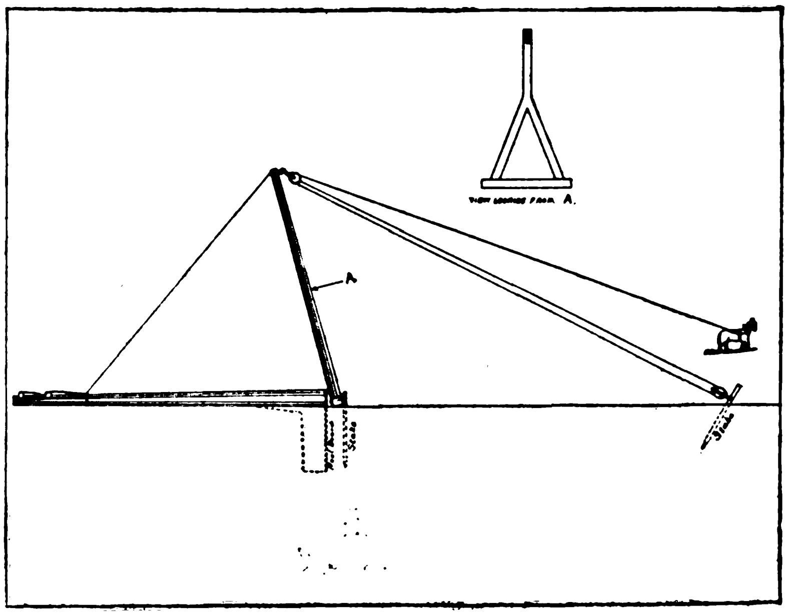
*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

Many of them had to be erected in wet and swampy ground where pikes could not be used. The poles were fitted up with cross-arms, pins and insulators, and erected by a horse pulling on a breast derrick, as shown in sketch. At the point where the rope from the breast derrick is attached to the pole to be raised, four or more guy ropes were attached, so that the pole could be lined up by a man pulling on the guy rope in any direction the pole had to go. The guys were fastened to the pole in such a way that by pulling on a small half-inch rope after the pole was in position all the ropes were dropped to the ground without the need of a climber to unfasten them. This arrangement proved to be a great saver of time and labor.

G. A. Montgomery, Montgomery, Ala.



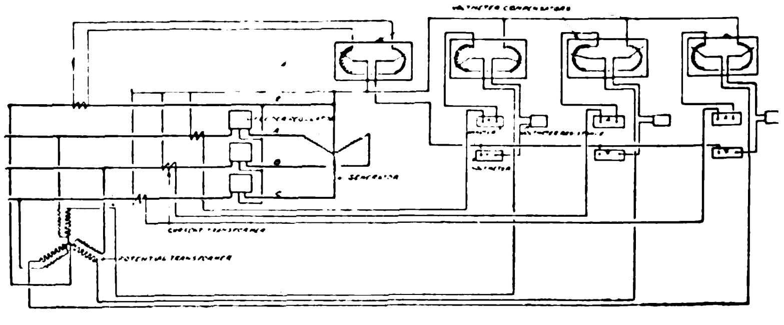
Raising Pole.

Voltmeter Compensators on Four-wire, Three-phase Circuits.

In order to secure maximum efficiency of feeder copper in connection with single-phase lighting circuits on three-phase four-wire distribution systems, three single-phase feeders running along the same pole line for a portion of their length should be combined along such portion into four-wire, three-phase feeder. The loads on the three feeders will, in general, be unequal, and the common neutral wire will carry the unbalanced current. Under these conditions, and where voltmeter compensators are used in the station, some difficulty has been experienced in securing on the feeder voltmeter a correct indication of the voltage at the feeder ends. The diagram herewith shows a scheme of connection for voltmeter compensators which accomplished this result.

It will be noted that a voltmeter compensator is installed on the neutral wire as well as on each phase wire. The neutral compensator is adjusted to compensate for the drop in that portion of the neutral wire that is common to all three circuits. Each of the compensators on the phase wires is adjusted to compensate for drop from the end of the common neutral to the feeder end and back to the station. In other words, the compensator on each phase wire is adjusted to compensate for the drop in that portion of the circuit traversed by the current shown by the ammeter on that phase, and the neutral compensator is adjusted to compensate for the drop due to the unbalanced current in the neutral wire. In general, current in the neutral wire will not be in phase with the current in any of the phase wires, but if the connections of the compensators are made as shown, and the compensators properly set, the voltmeters at the station will indicate the voltage at the end of the single-phase feeders regardless of the distribution of load on the the three circuits. It is always advisable to check the compensator settings by observations of the voltage at the feeder end.

D. W. Roper, Chicago, Ill,



WIRING DIAGRAM OF VOLTMETER COMPENSATORS FOR 4 WIRE 3 PHASE FEEDERS

Wiring Diagram.

Not Ready for Municipal Ownership.

Although Mayor Dunne, of Chicago, refuses to make public the contents of the report of James Dalrymple, of Glasgow, who inspected Chicago's street railway system, with a view of advising the officials upon municipal ownership plans, it is declared that an article on Chicago, in the "London Tramway and Railroad World," gives the essential features of his report. In this article Mr. Dalrymple says in part:

"I would be much astonished if the city could afford to purchase the undertaking, including the value of the unexpired franchises. The city council is a very able and intelligent body, but if it went in for municipal ownership it would have to eliminate the political element.

"If Americans could eliminate their present method of political influence, they would quickly make a considerable advance in municipal ownership affairs. They have a large number of bogus claims for alleged accidents, because a street railway company can never get justice from an American jury.

"The discipline of the employes is not quite as good as here. They are more thoroughly organized, are a bit more independent and on the whole have got more power than they ought to have."

Trunk Line Operation.

In the current issue of the "Century" Mr. Frank J. Sprague has written an interesting article on traffic problems in which he says that "there are nearly 30,000 miles to the credit of the electric railway in the United States alone, but the character of the traffic and the house-to house service performed by a large portion of it is essentially distinctive, and reason enough for its creation irrespective of the condition and requirements of trunk-line operation. Save on elevated and underground roads of short length, it has been essentially a service of single cars at frequent intervals and convenient stops. But it is hardly necessary to point out that trunk line operation as at present conducted consists largely in the dispatching of heavy units at frequent intervals over long distances, and this is maintained in the United States on over two hundred thousand miles of road, or fully half a million miles of track, with terminals, routes and service in the main well settled, and on which exists a system of train make-up and interchange of cars, both freight and passenger, which cannot be readily changed. Yes, right in the metropolis of the United States we are confronted with grave and complicated problems incident to local conditions which are calling for an expenditure of nearly eighty millions of dollars, supplementing the electrical equipment of the surface, elevated and underground lines, all made possible chiefly because of the electrical development. And the solution of these problems will demonstrate that, so far as speed and power are concerued, the maximum capacity of any steam locomotive will be more than equaled. If so, then it may be asked, Why does it not settle the trunk-line problems? Largely because the conditions are special in character, and must be solved, simply because they can be, without too great regard to cost."

Municipal Electricians' Convention.

The tenth annual convention of the International Association of Municipal Electricians will be held at Erie, Pa., August 23, 24 and 25. The following papers will be presented and discussed:

"The Effects of Electrostatic Influence in Telephone and Telegraph Circuits," by H. R. Allensworth, Columbus, O.

"The Advisability of Fusing Fire and Police Telegraph Boxes," by C. E. Diehl, Harrisburg, Pa.

"Electric Light Engineering," by A. S. Hatch, Detroit, Mich.

"Erection and Maintenance of Electric Lighting Plants," by C. L. Williams, Meridian, Miss.

"Suggested Improvements in Fire Alarm Telegraph Systems," by Capt. Wm. Brophy, Boston, Mass.

"The Necessity of a Rigid Inspection by the Municipality," by T. C. O'Hearn, Cambridge, Mass.

"Underground Construction," by Louis Gascoigne, Detroit, Mich.

Change in Presidency of Schenectady Road.

The announcement is made in Schenectady, N. Y., that Hinsdill Parsons has resigned as president and director in the Schenectady Railway Company. General Manager E. F. Peck, of the company, it is stated, will succeed him. The recent sale of the control of the road to the New York Central interests by the General Electric Company is undoubtedly the cause for the change. Mr Parsons is the fourth vice-president of the General Electric Company.

Edison's Automobile Battery.

Mr. Thomas A. Edison announces that he will have a new storage battery for autos on the market this fall. "The cost of operation," he said "has been found to be 58 per cent. of that of horses. I am prepared to make the unqualified statement that the Edison battery will revolutionize the storage battery problem. The new light battery is an accomplished fact. It will weigh just one-half of the present battery in general use, and will be about the same size."

Electric Railways on Canadian Frontier.

Mr. Frederick Nicholls, president of the Toronto-Niagara Power Company, has been telling the mayor and the members of the common council of the city of St. Catharines, Ont., that his company is about to carry out a scheme for electric railway building on the Canadian-Niagara frontier and in the Niagara peninsula, which will make St. Catharines one of the greatest electric railway centers in the country.

Old-Time Telegraphers' Reunion.

A large attendance is expected at the 25th annual reunion of the Old-Time Telegraphers and of the Society of the United States Military Telegraph Corps to be held in New York City at the Waldorf Astoria, August 29, 30 and 31 and September 1. Mr. John C. Barclay, general manager of the Western Union, is president of the Old-Timers, and Mr. W. B. Wilson, of Philadelphia, is head of the Society. The banquet will take place August 31. Business meetings will begin on Tuesday, the 29th.

Alleged Robberies Cause Bankruptcy Petition.

A petition in bankruptcy has been filed against the Joseph Menchen Company, manufacturer of electrical appliances and stage lighting apparatus at 354 West 50th street, New York, by the following creditors: E. B. Latham & Co., Elmer T. Morris Company and the International Brass & Electric Company. It was alleged that the company is insolvent, and permitted certain creditors to obtain a preference by legal proceedings. Joseph Menchen is president of the company. It is said that the principal cause of the embarrassment is losses of materials by robberies at various times. Le Roy S. Gove has been appointed receiver.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED JULY 25, 1905

Electric Railways and Appliances.

795,285. Electric Switch. William S. Jackson, Hoboken, N. J. Filed Aug. 27, 1904.

795,322. Railway Block-Signal System. Ludwig S. Walle, Brooklyn, N. Y., assignor to Fridtjof Jebsen, Bergen, Norway. Filed Dec. 29, 1903.

795,452. Trolley-Wheel. William K. Richardson, Leavenworth, Kan., assignor of one-half to Martha L. Richardson, same place. Filed Oct. 17, 1904.

Electric Lights and Appliances.

795,492. Incandescent Electric Lamp. Timothy G. Dineen, St. Louis, Mo. Filed Aug. 6, 1904.

795,681. Electric-Arc Light. Heinrich Beck, Meiningen, Germany, assignor of one-half to the Physikalisch-Technisches Laboratorium G. M. B. H., Meiningen, Germany, and one-half to the Allgemeine Lichtgesellschaft mit Beschrankter Haftung, Berlin, Germany. Filed Jan. 21, 1904.

Electrical Machinery and Apparatus.

795 340. Circuit-Closer. Eugene R. Carichoff, East Orange, N. J., assignor to the Sprague Electric Company. Filed Aug. 25, 1900.

795 369. Automatic Controller. Ernest Schattner, Schenectady, N. Y., assignor to the General Electric Company. Filed July 8, 1904.

795,392. Automatic Regulator for Alternating Current Motors. George H. Hill, Schenectady, N. Y., assignor to the General Electric Company. Filed Jan. 15, 1904.

795,462. Electric-Control Apparatus. William A. Turbayne Lancaster, N. Y., assignor to the Gould Coupler Company, New York City. Filed Sept. 15, 1904

795,481. Dynamo-Electric Machine. Henry Chitty, London, Eng. Filed April 11, 1907.

795,541. Apparatus for Electric Welding. John C. Perry, Clinton, Mass.; William S. Perry executor of said John C. Perry, deceased; said executor assignor to the Clinton Wire Cloth Company. Filed March 23, 1901. Renewed Jan. 7, 1905.

795,570. Current-Controller. Swen G. M. Anderson, Chicago, Ill. Filed Jan. 27, 1904.

795,670. Electric Controller. William R. Whitehorne, Bethlehem, Pa. Filed March 28, 1905.

795,780. Alternating-Current Motor. Maurice Milch, Schenectady, N. Y., assignor to the General Electric Company. Filed Jan. 2, 1904.

Telephones and Telephone Apparatus

795,403. Telephone-Call Register. August Meyer, Baltimore, Md. Filed Aug. 24, 1904.

795 532. Selective Signaling Apparatus. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company. Filed April 4, 1901.

795,533. Telephone Exchange Apparatus. Frank R McBerty, Evanstop, Ill., assignor to the Western Electric Company. Filed Sept. 28, 1903.

Miscellaneous.

795,318. Annunciating Mechanism. Charles E. Trump, Philadelphia, Pa., assignor to the Novelty Electric Company, same place. Filed July 28, 1904.

795,396. Elastic-Fluid Turbine. Oscar Junggren, Schenactady, N. Y., assignor to the General Electric Company. Filed April 29, 1903.

795,402. Telegraph and Like Cable. Oliver J. Lodge, Birmingham, Eng. Filed Dec. 9, 1904.

795,467. Electric Terminal Bond. Henry J. Wessinger, Duluth, Minn. Filed April 15, 1904.

795,512. Electric Railway Signal. Charles F. Hoover, Lockport, N. Y. Filed Jan. 12, 1904.

795,538. Protective Device for Electric Circuits. Joseph J. O'Connell, Chicago, Ill., assignor to the Western Electric Company. Filed July 20, 1904.

795,607. Electrician's Tool. Arthur E. Haff, Adams Mass. Filed Feb. 14, 1905.

795,726. Electric and Pneumatic Governor. William H. Nightingale, Philadelphia, Pa., assignor to John E. Reybnrn, same place. Filed July 16, 1904.

795,762. Wireless Telegraphy. Manual R. Garcia, Paris, France. Filed Jan. 10, 1901.

795,803. Electrical Resistance. Elise Vedovelli, Paris, France. Filen May 23, 1904.

THE TELEPHONE WORLD.

Independent Company in Syracuse.

After a long fight a deal has been closed whereby the Independent Telephone Company, recently organized by capitalists of Syracuse and Rochester, N. Y., comes into possession of the Crouse stable in South State street, Syracuse. The building will be remodeled for telephone offices.

A new switchboard has been ordered to cost $175,000. It will be constructed by the Stromberg-Carlson Telephone Apparatus Company of Rochester.

It is expected that the company will be ready to give public service by December 1.

The company's engineers are in Syracuse to look over subways and other necessary preparations for the installation of the new plant.

England May Control Telephones.

A cable dispatch from London says that unless all indications are wrong London, and probably all England, may have a telephone system owned or controlled by the Government. A special committee, elected by the House of Commons and led by Stuart Worthley, is even now looking into the mass of correspondence exchanged between the Postmaster-General and the National Telephone Company for the purchase of the company's property by the British Government.

In the House of Commons, as well as in the business world, there is an overwhelming opinion in favor of Government ownership of telephones. The controller of the London County Council says that he hopes that if the Government purchases the telephone system a reduction of charges will soon follow, so that the charge for a call in London proper will be only three cents, and this both he and the chairman of the committee think will greatly increase the general use of the telephone.

The Kinloch Long-Distance Telephone Company of Missouri lately filed a deed of trust in the Recorder's office in Clayton, for $5,000,000. The loan is secured by all its property, both tangible and intangible. The deed was given to the American Trust & Savings Bank, and George W. Galbraith, trustee. The loan bears 5 per cent. interest and will mature January 1, 1929.

The Farmers' Telephone Company, Cochrane, Wis., is a mutual concern, with the following incorporators: Fred Putz, Fred Hansen, R. C. Hener, E. C. Miller, Herman Putz, Albert R. Suhr, George Muehlelsen, G. Klein, G. Bass, J. H. Herold, James B. Hope, John Staak, William Huth, Edward Hornburg, A. R. Mohuk and W. M. Belitzen.

Telephones may play a prominent part in the settlement of differences between the railway telegraphers and officials of the Northern Pacific and Great Northern roads. The system is so complete on the the Rocky Mountain didivisions of the two roads that it could be used in case of a strike of telegraphers.

The Home Telephone Company, of Louisville, Ky., has purchased a franchise for a telephone system in Pewee Valley. The franchise was sold by the board of trustees of Pewee Valley, and was purchased by D. H. French for the Home Company.

The Bell and Keystone Telephone Companies' Business.

The "new blood" in the Keystone Telephone Company of Philadelphia is causing the Bell Company, of that city, a little uneasiness. The indications are that this year the Keystone will earn net fully one and one-half times the amount required to pay the interest on the $4,000,000 5 per cent. bonds it has just sold, and the Bell, which pays 6 per cent. dividends, should show at least 10 per cent. earned or $600,000 surplus over the $840,000 necessary for the dividend.

The announcement that the Keystone plant has cost $5,053,000 to date, shows that this company now has an investment in plant equal to nearly one-half the cost value at which the Bell Company carries its plant on its books.

Mr. Bryan Wants Cities to Own Telephones.

At Lima, O., Mr. William Jennings Bryan, in an interview, declared for municipal ownership of telephones.

"A city should have only one telephone system," he said. "More than one works an unnecessary hardship upon the business and professional people, who are forced to rent two or three telephones, when one should be sufficient. One system of rural telephone service is sufficient, and that should be owned by the county. The city should own its system."

District Manager E. W. Adams, of the Central New York Telephone & Telegraph Company, has resigned, and William Bedell, who has been wire chief, will succeed him as district manager. The change goes into effect this week. The company has recently installed a number of services in the country by what is called "10-party lines." Ten telephones are connected with each line and the line connected with the general exchange. One recently completed is in North Syracuse, and another is being placed in the vicinity of Warner.

A. T. Perkins, of St. Joseph, Mo., division superintendent of the Burlington Railway, recently said that the Burlington is considering the construction of a new telephone service between Kansas City and St. Joseph for use in general operation of the line. The Burlington now has one set of telephone wires in use between the towns, and they are giving such satisfaction that the new ones have been asked for.

W. C. Prichett, engineer for the Southwestern Telegraph & Telephone Company, is in Laredo, Tex., drawing plans and forming estimates for the installation for a new exchange system and plant. He says that the workmen will be sent immediately after his preliminary work is done and that before the end of this year the new plant will be installed and in operation.

The Eureka, Cal., telephone franchise was sold by the city council to W. W. Allen, an attorney of San Francisco, for $3,000, twenty-five per cent. of which was deposited with the city clerk. Allen refuses to state whom he represents.

New England Telephone Company Increases Capital.

The directors of the New England Telephone & Telegraph Company have voted to increase the capital stock of the company to the extent of 30,860 shares of $100 each for the purpose of providing funds for the payment of its third series of bonds due in 1906, and for the extension of the property and business of the company.

The new stock will be issued at par to stockholders of record at the close of business August 19 in the proportion of one new share for every eight shares now outstanding.

With the advance in telephone rates recently put in force at the office of the Cortland, N. Y., Home Telephone Company, the business of the company is falling off. Already many 'phones have been ordered out of the residences and during the present month a large number will be taken out. The rates for business places have been raised from $24 to $30 a year, and in residences the rate has been jumped from $12 to $18 on single lines and from $12 to $15 on party lines. Although the company is run under the name of a local corporation, it is practically under the control of the Bell Company, it is said.

Pursuant to a decree by the court of common pleas of Bucks County, Pa., all the lines of telephone and telegraph franchises, leaseholds and all other property, real and personal of the Standard Telephone & Telegraph Company, will be sold at public sale at Doylestown on Saturday, August 12, at 11 A.M., at the Bucks County Trust Company. The upset price fixed by the court is $24,000. The property includes three pieces of real estate in Doylestown, Newtown and Bristol.

A telephone company has been organized by the Grand Marais, Mich., business men, and the work of installing the system will be commenced as soon as the material, already ordered, has arrived from Detroit. C. C. Smith is president and R. E. Schneider, secretary. A list of 150 subscribers is expected within a few months. The line will connect with the Government system extending from the lighthouse to the life-saving station at Whitefish Point.

The Burning Springs and Booneville, Ky., Telephone Company has completed a telephone line from Burning Springs to Booneville, giving connection to Booneville. The town never had a telephone or telegraph connection before. It is now possible to make a connection with any point in the State.

The ordinance regulating telephone rates within the city limits of St. Paul, Minn., was killed in the board of aldermen, later resurrected by a vote to reconsider and its consideration finally postponed until the second meeting in August.

Telephone Incorporations.

The Milledgeville Mutual Telephone Company, Milledgeville, Ill. Capital stock, $10,000. Incorporators: T. H. Fleming, A. B. Puterbaugh and A. M. Fike.

The Southern Michigan Telephone Company Three Rivers, Mich. Capital stock, $300,000.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Chittenango, N. Y.—The trustees of the village have given an electric light contract to C. W. Bull, of Syracuse to light this village for five years.

Houghton, Mich.—The Superior Construction Company, of this city, is preparing plans. and specifications for the proposed municipal lighting plant at L'Anse.

Johnsonburg, Pa.—The Johnsonburg Electric Light, Heat & Power Company has been incorporated with a capital of $25,000.

Knoxville, Tenn.—A contract has been let for the construction of an electric light plant for Tennessee College at Fountain City. Before school begins, a complete electric light plant will be installed.

Milwaukee, Wis.—Specifications for lighting the streets and public buildings of this city under a new contract, requested by the common council, has been submitted to the council by the board of public works. They provide that the 1,926 lamps used shall be 480 watt instead of a 2,000 cp. light, as they are usually designated. Bids will be asked for a term of one, three, five and ten years.

Newman Grove, Neb.—At a special election the proposition to issue $6,000 in bonds for the purpose of establishing and erecting a lighting plant was carried.

North Manchester, Ind.—Dr. D. Ginther and others have been granted a franchise by the town council to establish a system for the transmission of electric light, heat and power in this city.

North Tonawanda, N. Y.—L. T. Palmer, manager of the Niagara Light, Heat & Power Company, has gone to Boston to consult the directors with a view to erecting an electric light plant.

Paul Smith's, N. Y.—The Paul Smith Electric Light & Power Company, with its principal offices here, has been incorporated.

Pittsburg, Pa.—An electric light rate war has been started in the towns in the Upper Monongahela Valley. The Monongahela Light & Power Company had a monopoly of the lighting business until an Independent concern of Turtle Creek, the Rose Hill Electric Light Company, entered the field. The new company will furnish light to three of the seven boroughs in the Turtle Creek Valley and the Monongahela Company has brought down its rates more than one-fourth.

Pontotoc, Miss.—At an election here recently the issuing of bonds for a modern electric light plant to be owned and operated by the city, was voted upon and carried. This means the immediate installation of an up-to-date system.

Springfield, Mass.—The United Electric Light Company, of this city, has filed a statement of its condition on July 20, 1905, with the Secretary of the Commonwealth. It shows profit and loss of $88,605, against $81,268 one year ago.

Union City, Tenn.—The councilmen at their last meeting decided that the town was sufficiently large to have a few arc lights, which will soon be put in, and which will doubtless be followed by others.

Wilson, La.—This town contemplates installing an electric light plant and waterworks. Address the town clerk.

York, Pa.—The bonds of the York & Windsor Electric Light Company are ready for delivery.

STREET RAILWAYS.

Berkeley Springs, Md.—Two West Virginia capitalists will appear before the Morgan County Court here August 12, and file an application for a franchise over the county road from this place to Hancock, for the purpose of constructing an electric trolley line.

Cincinnati, O.—It is stated in well-informed circles that the deal for the purchase of the Dayton & Western Traction Company, by the Widener-Elkins-Dolan Syndicate, is off. This road is desired by President Schoepf, of the Cincinnati Traction Company, as a part of his river-to-lake trolley line. It is believed, however, that the negotiations will be resumed in the fall.

Fitchburg, Mass.—The aldermen granted a franchise to the Fitchburg & Princeton Street Railway Company, whose stockholders are the same men who own the Worcester & Northern and the Worcester & Holden. They have already begun building north from Holden, and will make almost an air line from here to Worcester.

Lima, N. Y.—The franchises, rights of way, property and assets of the Lima-Honeoye Electric Light & Railroad Company have been sold by Receiver Hill to William J. Connors, of Buffalo. The price paid was $16,000. It is understood that the road will now be extended.

Macon, Ga.—If there should be any hitch in building the proposed trolley line between this city and Atlanta, the indications are that a big Western firm will immediately take up the work and get electric cars running between these two Georgia cities. At least that is what the officials of the firm say in a letter received by Mayor Smith.

Rochester, N. Y.—Clifford D. Beebe, general manager of the Rochester, Syracuse & Eastern Railroad, says that 37 miles of double track between Rochester and Lyons will be in operation by November 15. The road will be constructed as far as the canal bridge in the village of Lyons, where it will stop until after the exact route for the barge canal has been decided upon.

Springfield, O.—The stockholders of the Springfield, South Charleston, Washington & Chillicothe Traction Company decided to have the receiver sell the property as soon as the requisite order of court can be obtained.

Syracuse, N. Y.—Horace E. Andrews, president of the Utica & Mohawk Valley Railway Company, says that the work of electrifying the West Shore Railroad has been commenced, and that early next spring electric trains will be in operation between this city and Utica. The cars will be operated on the multiple unit control system, similar to the subway and elevated trains in New York. The speed will be equal to that of the average steam railroad trains on the Central, and there will be trains in both directions every hour and sometimes a half hourly service will be operated.

Toledo, O.—Work will be begun soon on the grade for the Toledo, Port Clinton & Lakeside Electric Line between Genoa and Toledo.

Toronto, O.—The prospects are now almost certain for connecting Wellsburg and Bethany by an electric trolley line.

POWER PLANTS.

Dover, Del.—At the State Department, certificates of incorporation were issued to the Yaco Company. It is to purchase, acquire, construct and operate power plants for the distribution of gas and electricity. The incorporators are chiefly of Wilmington. The capital stock is $1,000,000.

Ft. Wayne, Ind.—The plans for the $1,000,000 power house of the Ft. Wayne & Wabash Valley Road have arrived and bids for its construction will be opened this week The plans call for the production of 10,000 hp., and when carried out will make the most up-to-date power house in the United States. The turbine engines will rest on a solid base immediately over the boilers.

Lockport, N. Y.—In the test case involving the right of the Niagara, Lockport & Ontario Power Company to build an electrical transmission line from the Niagara River, in addition to constructing a power canal, Justice Kenefick decided in favor of the power company.

Pittsburg, Pa.—The War Department at Washington has granted permission to H. P. Dilworth, Charles Arbuckle Jamison and Stuart Robinson to use the water flowing over the Springdale dam in the Allegheny River for power purposes. A power plant to cost $400,000 will be erected and electricity for lighting and power throughout the Allegheny Valley will be produced. The strong current in the Allegheny induced the Pittsburgers to apply for the right to build a plant.

BIDS WANTED.

Washington, D. C.—The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until August 8 for furnishing the Navy Yard at Pensacola, Fla., with the following: Schedule 44, electrical supplies, cable and telephone wire. On August 15 the Bureau will open bids for furnishing Western Navy Yards with the following: Schedule 46, telephone cable; schedule 47, conduit, voltmeters, ammeters, circuit breakers, switches, lights, Grimshaw and Okonite tape, wire, cable and micanite board. Blank proposals and detailed information will be furnished on application to the Bureau at Washington. The Bureau will also receive sealed proposals until August 8 for furnishing Eastern Navy Yards with the following: Schedule 39, electrical conductors, cable, wire, ventilating sets, annunciators, testing sets, cells, etc.; schedule 42, motors. Blank proposals can be obtained at the Navy Pay Office in New York or of the Bureau.

Williamsport, Pa.—Sealed proposals will be received by the light committee of the council of the Borough of South Williamsport, Pa. until August 10, for lighting the streets, alleys, thoroughfares and parks of the borough with the most modern system of electric lighting, every night and all night, for a period of one year; also for a period of three and five years from October 1, 1905. Bids to state the kind and number of lights to be furnished, the system of lighting, the candle power and distribution of lights. Address W. L. Regelman, Chairman Light Committee.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15¼@15½c.; Lake 15¼@15½c.; casting, 14⅞@15⅛c.

The report is again revived that Metropolitan Street Railway of New York is to be taken over by the Interborough at $150 per share.

It is officially stated that the Electric Storage Battery Company in the last three months earned enough to pay its next two quarterly dividends.

Directors of the New England Telephone & Telegraph Company have declared a regular quarterly dividend of 1½ per cent., payable August 15.

It is said, semi-officially, that the gross earnings of the Brooklyn Rapid Transit Company for July will show a gain over last year of about $200,000.

Notwithstanding the trouble with its employes the United Traction Company of Albany, N. Y., has declared the usual quarterly dividend of 1¼ per cent.

The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent. on its preferred stock, payable August 15. Books close August 5 and reopen August 16.

The industrial dividends for August thus far declared and those yet to come show a gain approximating $1,100,000 over those of August a year ago, the total this year footing up $15,710,529.

Stockholders of the Massachusetts Electric Companies voted to issue $3,500,000 four and one-half per cent. 5-year gold notes to refund a like issue authorized January 1, 1901, of which $2,700,000 are now outstanding.

It is said that Canadian capitalists are seeking investments in Mexico and that a group of Montreal men incorporated the Mexican Electric Light Company with a capital of $6,000,000 and will deal in electric light, heat and power in Mexico.

It is announced that G. Martin Brill, of the J. J. Brill Company of Philadelphia, has consented to act as president of the proposed new combination of street car builders, which will control, it is said, 95 per cent. of the business in this country.

For the purpose of securing its recent $10,000,000 issue of bonds the Portland General Electric Company in Portland, Ore., placed a blanket mortgage on its entire plant for $10,000,000. The mortgage was given to the United States Mortgage & Trust Company of New York.

Thomas E. Mitten, formerly vice-president, has been elected president of the Chicago City Railway Company and Lawrence A. Young has been elected first vice-president. This action is construed to mean that the company will proceed with the rehabilitation of the system.

The recent advance in General Electric was accompanied by a revival of the reports that the company has acquired the Allis-Chalmers property. The purchase of this property was reported to have been made several months ago, but at that time the report was positively denied by all the parties in interest.

The Morris County (N. J.) Traction Company has made a mortgage to the Trust Company of America to secure $3,000,000 five per cent. 30-year bonds, redeemable at 110. The company has $400,000 of its $3,000,000 capital stock outstanding and has already in operation 7½ miles of traction road from Wharton via Dover to Rockaway, N. J. It proposes about 60 miles of additional road through Springfield, Union and Milburn.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price July 31
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	202½
Manhattan Elevated Railway	165⅛
Metropolitan Street Railway	128¼
Metropolitan Securities	82⅝
Ninth Avenue	197
Third Avenue	128¼
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	69¾
Brooklyn City Railway	239
New Orleans Railway	31
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	82
Philadelphia Traction	100
Union Traction	59¾
Boston.	
Boston Elevated	157
Massachusetts Electric Companies, com	18
do. do. do. pref	63½
West End Street, com	98
do. do. do pref	114⅛
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	9⅞
do. do. pref.	39⅛
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	19¼
do. pref.	63
Electric Boat, com	28
do. do. pref.	65
Electric Vehicle, com	18
do. do. pref.	27
Westinghouse, com	170¾
do. pref.	194
General Electric	180¾
Boston.	
Edison Electric Illuminating	243¾
General Electric	181
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	157½
National Carbon, com	65
do. do. pref.	118
Philadelphia.	
Electric Company of America	11¾
Electric Storage Battery, com	84
do. do. do. pref.	84
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	139
Western Telephone Company	17¾
New England Telephone Company	135½
New York.	
American Telegraph & Cable Company	90½
Commercial Cable Company	210¼
Mexican Telephone Company	1⅛
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93⅛
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Chicago Subway	86⅛
Otis Elevator Company	58
Standard Underground Cable	..
Twin City Rapid Transit	114⅝

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EDITORIAL NOTES.

Will the Electric Auto Win Out?

Faithful as he is to the very last, we will not be sorry to see his exit from the city streets. The automobile and auto-truck have marked time for five years, but the experiment has been conducted with satisfaction and the horse must go. But whether his departure will leave behind a definite and specialized solution of the problem, or whether the city streets will remain the scene of a variety of species of "autos" is at first glance a hard proposition to solve. There are three lines of argument represented by an equal classification of machines. The gasoline, steam and electric vehicle are working out their salvations side by side. They are numerous individually and collectively, yet seem to have found, through the influence of experience and observation, their particular fields of service. The gasoline is the ruling element in the contemplation of practical automobile problems. Such of the steam cars as have arisen above the plane of mediocrity in equipment and staying power, in fact, such of these as embrace the necessary features of successful operation belong to second place in this category of functions. And then, belonging to a particular classification, derived as it were from its limited scope, through unlimited possibilities, the electric auto makes its appearance. It is readily understood that limitations in this case belong to the order of temporary events, if any trust can be put in the drift of modern science. It is not a mere matter of speculation to believe in the greater future of electricity in connection with this gigantic problem of street vehicles. The battery turned out by Mr. Edison offers a partial solution of the problem. The weight in this case is less than 45 pounds per horse power with a great element of durability. But whether it be the work of one, or the result of the efforts of many, the idea relates not so much to the details as they appear at present as the hopes that lie in the future. On this score much may be said, by reference to the suggestions of our best electro-chemists. In addition, the great sight-seeing cars are exemplifications of this idea as well. In some of these a complete gasoline electric plant is installed, with the ultimate purpose of securing, as far as the operation of the vehicle is concerned, electric control.

Electric control, therefore, offers the innumerable advantages that make it, in theory and practice, rise far above the efforts made in other directions. Electric control means the elimination of the chauffeur's attention from the mechanism to the road. The levers left to operate with merely consist of the power and guiding handles, the brake being operated by the feet. The electric vehicle, however, is not a perfect machine to-day. It is but justice to admit that the imperfection does not lie in the vehicle as such itself, but in the battery power. The lacking capacity here must be overcome before it assumes pre-eminence. Otherwise it is the acme of perfection to those making short trips, to the proprietors of sight-seeing carryalls and to the owners of heavy slow-moving heavily weighted express or brewery wagons.

* * *

Japan's Great Electric Plants.

The Tokio Shigai Tedsudo, the name of the Tokio Street Railway, is capitalized at fifteen million yen, about seven million five hundred thousand dollars of our money. It is to-day the largest electrical enterprise in Japan, and so far as its future development is concerned, is destined to be the scene of the most extensive, as well as the most rapid expansion in electric railroading in the Orient. While this may not seem to be saying much, it is intensely important, with respect to what has recently been advertised in the public print. And these facts are of such a nature that Japan rises, at one swift bound, to a position second to none if not superior to all European countries, as far as her electrical institutions are concerned. Thirty-seven turbo electric plants have been ordered by Japan, aggregating a total of thirty-five thousand horse power, for use in Tokio and other large cities in her provinces. In lighting capacity the total would equal four hundred thousand lamps. In power equipment it speaks for itself. Electricity is being extensively used in Japan for both street and interior lighting. It finds a large and constantly growing application for many industrial enterprises.

The street railways are forming a complete network under the stimulating influence of American and English capitalists. The networks are connecting town with town, city with city, the suburban with the urban districts. The great coal mines are on the point of undergoing a complete rehabilitation by the introduction of electricity for the drilling, carrying, lighting and ventilating of the mines.

The story of this incomprehensible rise of Japan to a position among the first of the great nations in the utilization of the science and arts of the day, in the assumption of power, in the exhibition of a calm and obvious spirit of justice, in the love of all the intricacies relating to scientific research, in medicine, surgery, industrial fields of occupation and agriculture, in carrying out to fulfillment stupendous tasks with comparative alacrity and ease, reads like a fairy tale.

But when we discover in the manner of giving and handling franchises for public utilities, as in the case of her Tokio Street Railway, that in this instance the franchise provides that after 1932 the municipality may acquire the line by paying an adequate price for it, a certain Utopian spirit seems to appear, in marked contrast with the method prevailing in many other lands. In July, 1904, Japan received news of the first big shipment of turbines to her shores. Since that time American enterprise, more than any other, more even than her ally England, has erected power plants and installed systems that place her among the largest consumers of electrical devices we have. Geographical terms will soon represent less inherent national differences than differences in language or manners. Nippon is an anomaly yielded by no other precedent, and in which we believe the only peril residing, now fast disappearing, is that of ignorance. Buying, as she now is, more freely in the way of the most improved machinery than even her antagonist Russia, it seems that the entire trend of her efforts is to be supermodern, and in this respect, by being modern, she successfully sweeps away the thickly settled dust of antiquity.

If the arts of war make her one of our heaviest customers, the arts of peace will surely surfeit the Yankee ambition for orders as never before.

◆

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The eleventh annual convention of the Ohio Electric Light Association will be held at Hotel Victory, Put-in-Bay Island, August 16, 17 and 18. A large number of valuable papers will be presented, and there will be an illustrated lecture on "Illuminating Engineering," W. D. O'Ryan, Lynn, Mass., followed by a banquet. There has been provided, in addition, an elaborate programme for the entertainment of the ladies.

◆

A magnetic survey of the North Pacific Ocean will shortly be begun by the Department of International Research in Terrestrial Magnetism of the Carnegie Institution at Washington. The director of the work is Dr. L. A. Bauer, who likewise is in charge of the magnetic work of of the United States Coast and Geodetic Survey.

◆

A new electric fire and watchman's signal system, for whose installation the last Congress voted $8,500, is soon to be put in operation at the Charlestown Navy Yard. The system, which is practically identical with those being placed in the War, Navy and State Departments and the Public Printing Office at Washington, will be the first to be put into use in any navy yard or naval reservation in the United States.

◆

Among remarkable recent inventions are the pneumoslito, the topodict, the telemeter, the telephone-ears and the thermophile, which are described in the "Strand Magazine." The pneumoslito is an automobile especially designed for use on ice, but which can just as easily be used on land It is moved by a propeller wheel run by a 2¾ hp. electric motor, the propeller turning in the air and moving the carriage at a speed of 20 miles an hour. The topodict is a combination of a pantograph and telescope, by means of which any person can make a drawing in correct perspective of any scene before him, even if he knows nothing whatever of drawing. By means of the telemeter the exact distance of far-away objects can be measured and recorded. The "telephone-ears" is an apparatus by which a ship is automatically warned of submarine dangers. By the aid of the thermophile "it is possible to furnish heat by means of a fine electric wire which can be woven into rugs, blankets or cushions, and all that is required is a very small electric battery. The inventor claims for it that it will do away with the necessity of ever having fires in even the coldest of weather."

◆

The Colorado Electric Light, Power and Railway Association will hold its annual convention at Glenwood Springs September 18 to 20.

◆

A good mixture which will prevent the rusting of machinery, says an English publication, is made by dissolving one ounce of camphor in one pound of melted lard. After the impurities have been skimmed, black lead should be added to give the whole an iron color. After cleaning the machinery carefully and smearing it with the mixture it can be left indefinitely, or if wiped off after 24 hours it will obviate rust for some time. When removed, the metal should be polished with a soft cloth.

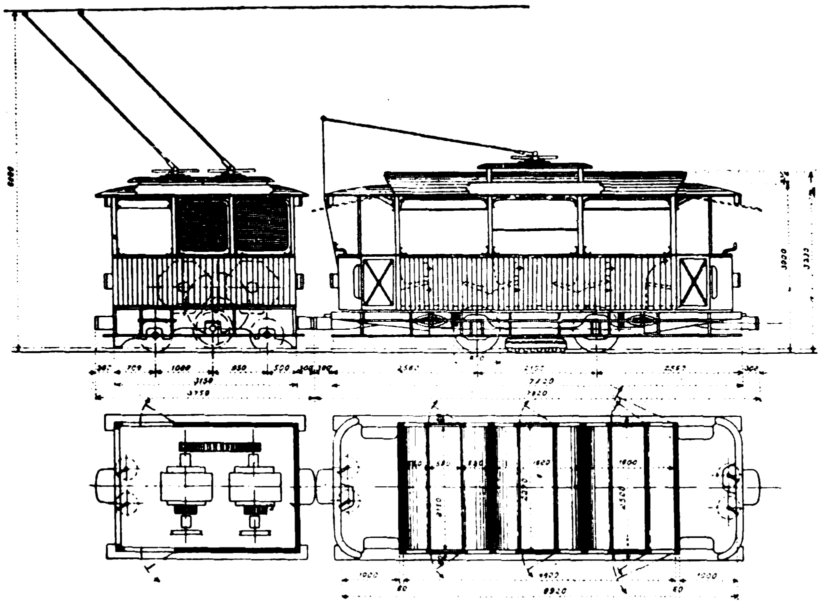
◆

The ozonizing plant of de Frise, erected on the grounds of the St. Maur pumping station near Paris, France, treats filtered water of the River Marne. It is capable of sterilizing 150 cubic meters of water per hour. The necessary power is supplied by a 45 hp. semi-portable steam engine, driving 110-volt Morley alternators and a centrifugal pump. A transformer is used that is capable of raising the pressure to a maximum of 80,000 volts, each ozonizer requiring a pressure above 20,000 volts. An ozonizer consists of a horizontal brass half-cylindrical trough fitted with a plate glass cover and a cast-iron water jacket. The trough is earthed and forms one pole. Across the trough, at regular distances, are brass half-disks, with serrated circular edges, 60 mm. smaller in diameter than the trough. These are fixed to the glass lid by means of screws which bring the high tension current from the liquid resistances fitted to each half-disk. For resistances, vertical glass tubes filled with a suitable liquid are used.

THE MT. VESUVIUS ELECTRIC RAILWAY.

BY FRANK C. PERKINS.

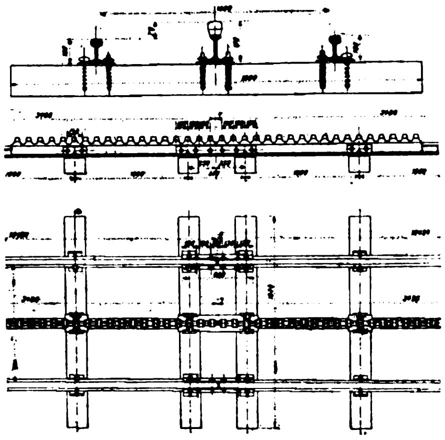
In spite of the fact of the recent eruptions at Mt. Vesuvius, which have caused considerable damage in the vicinity of the volcano, the electric railway is said to be still in daily operation. A cable road was constructed two decades ago for the highest section of the Mt. Vesuvius Electric Railway. Since that time it has carried many thousand tourists to the top of the cone to within several hundred feet of the crater of the volcano. In 1888 the cable section was purchased by Thomas Cook & Son and the electric railway connecting this road with the Pugliano, about 4.7 miles in length, was constructed by them in three sections, two of which are of the adhesion type, while the third, between the two, about one mile in length is of rack and pinion construction.



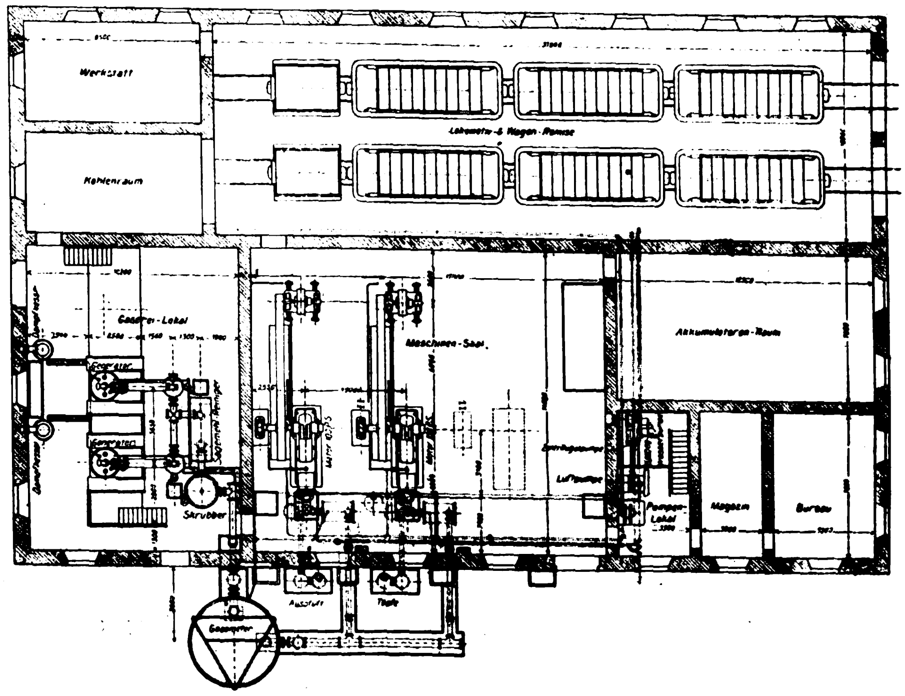
Electric Locomotive and Motor Car on Mt. Vesuvius Electric Railway.

The Strub system was employed, which is similar to the Jungfrau Mountain Electric Railway. At a point 793.6 meters above the sea level the cable line begins and rises to a height of 1,181.26 meters with grades varying from 35 to 65 per cent. The cable cars each carry 21 persons.

Hand brakes were well provided as a complete equipment of automatic brakes for both sets of wheels. About 12,000 persons are carried to the top of this cable line each year, the larger numbers during the months of March and April, the average being for these months more than 2,000 passengers.



"Strub" Rack on Mt. Vesuvius Electric Railway.

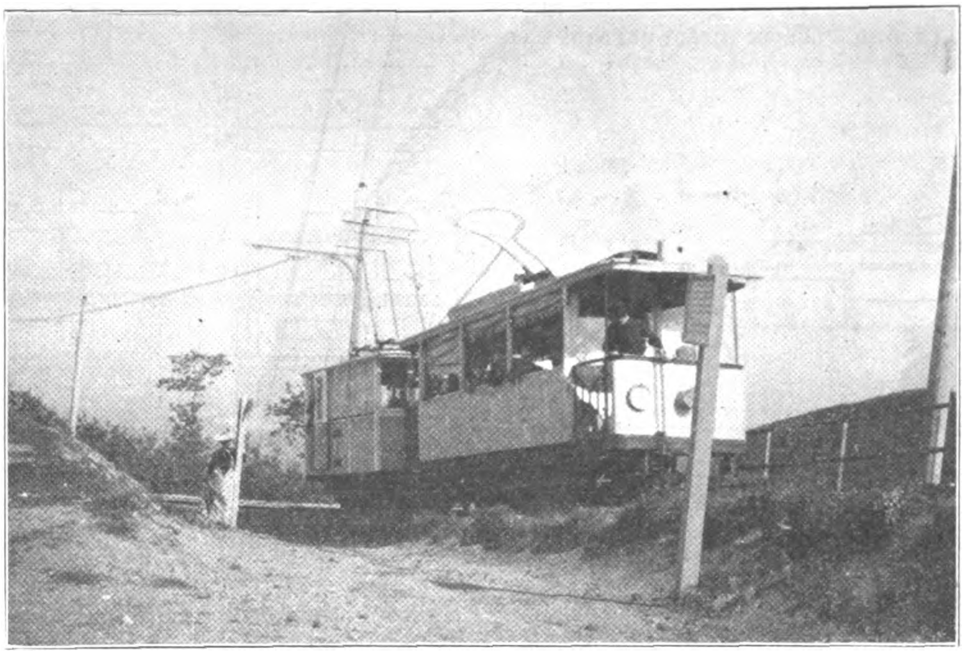


Power House of Mt. Vesuvius Electric Railway.

For supplying current for the Mt. Vesuvius Electric Railway, operating between Pugliano and the lower station of the cable road, an electric generating station was provided at the foot of the rack and pinion section, 249.6 meters above the sea level. The power station is provided with two gas engines constructed by the Schweizerischen Lokomotiv-und Maschinenfabrik of Winterthur, Switzerland. Each of these engines has a normal capacity of 90 hp. and operates a direct current shunt dynamo at a speed of 700 r.p.m. These direct current electric generators were designed for a maximum pressure of 770 volts, and supply a maximum of 137 amperes at a normal pressure of 550 volts. These machines are of the C. E. L. Brown type, having four poles, the magnet poles having a diameter of 250 mm. The armature of each machine is of 550 mm., and has a commutator of 255 segments. The dynamos supply current to a set of storage batteries consisting of 300 cells, which are used for taking care of the peak of the load and for regulation. The gas engines of the four cycle type with a stroke .76 m., and the cylinders measuring .52 m. in diameter. The electric locomotive used on the rack railway and the overhead electric construction of the Mt. Vesuvius Railway were supplied by the Aktien Gesellschaft, Brown, Boveri & Co.

Two motors, each having a capacity of 85 hp. are used on the electric locomotive and they operate at a speed of 700 r. p. m., and are of the four pole type, the magnets having a diameter of 235 mm. The armature of these machines each have a diameter of 450 mm. with 53 slots. The commutator in each case has 105 segments. The rack locomotive weighs somewhat over 10 tons and operates at a speed of from 6 to 8 km. per hour drawing a load of more than 10 tons. The locomotive is provided with emergency as well as hand brakes, together with automatic brakes, which are so arranged that the current is also shut off when the speed exceeds the limit decided upon.

The electric cars each weigh somewhat less than nine tons and are provided with single trucks having two axles, the wheel base measuring 2.1 m. Three compartments are provided for each car which seats eight passengers. The rack and pinion section of the road, which is about one mile in length, has very high grades, much greater than the adhesion sections, which do not exceed 8 per cent., the maximum for the former being about 25 per cent. The rails are fastened to wooden ties, the gauge being 1 meter. The rack rail is located in the center between the running, the height being 170 mm. above the iron plates, and the latter 100 mm. The accompanying diagram shows the rack rail as well as the electric cars, locomotive and power house construction.



Electric Locomotive and Electric Car on Rack Section of Mt. Vesuvius Electric Railway.

The station at Pugliano is 97.17 m. above the sea level and is 1,550 meters from Sanvito which stands 179.6 m. above the sea level. The distance from Sanvito to the central power station, which is at Monte Cateroni, is 1,705 m. The total cost of the Mt. Vesuvius Electric Railway, including the cars, track construction and power house, was about $250,000, or somewhat over $50,000 per mile. The cost of repairs is very high, especially on the upper section of this railway, where deposits of lava have given considerable trouble. A section of the road is shown in the accompanying illustration as well as the curious formation of lava, the mountain slope, and the observatory in the distance. The trip to the top of Mt. Vesuvius is a comparatively safe one, as a great deal of pains has been taken with the brake equipment of the cars and locomotives. It is possible for the motorman on the front of the car to operate the brakes of the locomotive in the rear and signal the engineer when necessary. Telephone communication is also provided between all the stations of the line and the power house.

From the power house to the observatory, which is the rack and pinion section of the road, the distance is 1,641 meters. The total distance from the royal observatory to the Funicular station is 2,695.5 meters, which makes a total length of electric railway of nearly five miles, and the trip over this section of the road takes less than one hour. The central power station was constructed so that the capacity could be increased by installing an additional gas engine and generator, as shown in the accompanying drawing. The engine room measures 17 m. in length and 14.5 m in width, and the gas generator room measures 10.2 m. in width, and 14.2 m. in length. The storage battery room has a width of 7 m. and a length of 12.5 m., while a car barn has been provided in the same building for the electric locomotive and motor cars with double tracks, having a capacity for six cars.

Royal Observatory and Lava Deposits on Mt. Vesuvius Telephone and Power Transmission Line.

The highest mountains of France, Italy and Switzerland, as well as America, are now accessible to the tourist by electrically operated mountain railways. The pleasures of the mountain scenes, formerly only within the reach of the hardy and strong, may now be enjoyed by those who could not exert themselves in the least at these high altitudes.

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ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

The Transmission of Power.

The Size and Weight of the Power Line.—The cost of the power line forms one part of the expense of its erection. The balance of the expense is discovered in the cost of the undertaking with regard to the poles, insulators, etc. The original law laid down by Lord Kelvin has undergone modification. His statement of the situation from an economic standpoint was as follows: "The interest on the cost of the copper of the line must be equal to the cost of the power wasted in the line." In other words, if the line cost $100,000, the interest at 6 per cent. being $6,000 represented the dollars and cents value of the power that could be wasted in it without overstepping the economic law governing the best conditions of practice. The best conditions of practice, as outlined by the best engineering done in this field, show an expense in the insulation which far exceeded the anticipations of the theorists originally dealing with the subject. Copper and insulation are of greater importance as regards the integrity of the plant and its serviceability for continued power transmission than was formerly believed, because of the extraordinary high pressures employed to secure economical transmission.

The following formulas are recommended by one of the largest electrical manufacturing concerns in the United States. They relate entirely to the questions involved in power transmission, namely:

1—The area of conductors in circular mils.

2—The pounds of copper of conductors.

3—The volts loss in line.

4—The current in the main conductors.

The area of the power line in circular mils is obtained by employing this formula:

Circular mils = D × W × C ÷ p × E^2
in which W = Watts delivered,
D = Distance of transmission in feet (one way),
p = Loss in line in per cent. of power delivered, that is, of W,
E = Voltage between main conductors at receiving or consumers end of the circuit.

The value of C = 2,160 for direct current, when T = 1, B = 1 and A = 6.04. The last symbols refer to characters used in formulas to follow. To obtain the value of the current in the main conductors, a formula of the following simple form is used:

Current in main conductors = W × T ÷ E.

If a power circuit carried a direct current the product of the watts by the value T with division by the pressure would give the total current. When the system is alternating, the value of T is obtained from the table for which it is given for single, two and three-phase currents:

PER CENT. POWER FACTOR,

	100	95	90	85	80
Single phase system, value of T.	1.00	1.05	1.11	1.17	1.25
Two phase system, (four wire), T...	.50	.53	.55	.59	.62
Three phase system (three wire, T	.58	.61	.64	.68	.72

Thus, in the formula W × T ÷ E, if T = 1 for direct current, for single-phase with a power factor of 100 it also equals 1, for two-phase it equals .50 and for three-phase .58. But ideal conditions like these do not exist in power lines except under extraordinary circumstances. When the power factor is 80, the value of T, which is 1 with direct current, becomes respectively 1.25, .62 and .72 with single, two and three phase currents. An illustration of this principle of application can be readily made evident by a case in which it is desirable to know the current in the main conductors with a given amount of power, say 100,000 watts, which is transmitted at a pressure of 10,000 volts by continuous current and single, two and three-phase currents, the power factor for all being 90.

With Direct Current—Current in main conductors equals 100,000 × 1 ÷ 10,000 = 10 amperes.

With Single-phase Current—Current in main conductors = 100,000 × 1.11 ÷ 10,000 = 11.1 amperes.

With Two-phase Currents—Current in main conductors = 100,000 × .55 ÷ 10,000 = 5.5 amperes.

With Three-phase Currents—Current in main conductors = 100,000 × .64 ÷ 10,000 = 6.4 amperes.

The relative values in this case when compared show differences representing the amount of copper necessary for 10 amperes with direct current, 11.1 amperes with single-phase, 5.5 amperes with two-phase and 6.4 amperes with three-phase. The increase in the copper required with single-phase transmission for equal quantities of power is the difference between 11.1 amperes and 10 amperes. The weight of additional copper over a long line would readily prove the disadvantage of this if it were not outweighed by other considerations, such as ready conversion before distribution and comparatively easy handling as regards insulation. A direct high tension current is not practical for power transmission because of the danger in attempting to secure insulation and commutation in direct current motors under these conditions.

The pounds of copper are calculated by the formula:

Pounds of Copper = D^2 × W × C^1 × A ÷ p × E^2 × 1,000,000.

The value of C^1 depends upon the system as well as A. Both are given in the following table, which covers the situation with regard to single, two and three-phase systems:

System.	Values of A.		Per cent. Power Factor 100	95	90	85	80	
Single phase.............	6.04	Values	2,160	2,400	2,660	3,000	3,380	Values
Two-phase (four-wire)...	12.08	of	1,080	1,200	1,330	1,500	1,690	of
Three-phase (three-wire)..	9.06	C^1	1,080	1,200	1,330	1,500	1,690	C^1

In the cases just cited, if the weight of copper for the single-phase system is calculated for a distance of 100,000 feet the result would be as follows, with a 90 per cent. power factor and a 10 per cent. loss.

Pounds of Copper for Single-phase System = 100,000 × 100,000 × 100,000 × 2,660 × 6.04 ÷ 10 × 10,000 × 10,000 × 1,000,000 =

$$\frac{100,000^3 \times 2,660 \times 6.04}{10 \times 10,000^2 \times 10^6} = \frac{10^{15} \times 266 \times 6.04}{10^{14}} = 16,066 \text{ lbs.},$$

where D = 100,000 feet,
W = 100,000 watts,
C^1 = 2,660,
A = 6.04,
p = 10,
E = 10,000 volts.

If the pounds of copper are to be known for a two and three-phase circuit under the same general conditions, an examination of the table will readily show that A for two-phase is 12.08, and C^1 for the same phase with a power factor of 90, has the value 1,330. A further examination will show for three-phase, the value for A of 9.06 and for C^1 with a 90 per cent. power factor 1,330. Arranging the items as before, the following data for calculating the weight in pounds of copper of a two-phase system presents itself:

where D = 100,000 feet,
W = 100,000 watts,
C^1 = 1,330,
A = 12.08,
p = 10,
E = 10,000 volts.

Pounds of Copper for a Two-phase System = $100,000^2$ × 100,000 × 1,330 × 12.08 ÷ 10 × $10,000^2$ × 10^6 =

$$\frac{10^{15} \times 1,330 \times 12.08}{10^{15}} = 16,066 \text{ lbs.}$$

These calculations show no difference in the weight of wire as indicated by the calculation of the current in the main conductors In the single-phase conductor the 100,000 watts called for an 11.1 ampere current at 10,000 volts pressure. In the two-phase system the transmission of the same amount of energy called for four wires, each carrying 5.5 amperes at 10,000 volts pressure. The data supplied in connection with a three-phase system with a power factor of 90 is as follows:

where D = 100,000 feet,
W = 100,000 watts,
C^1 = 1,330,
A = 9.06,
p = 10,
E = 10,000 volts.

Pounds of Copper for a Three-phase System $= 100{,}000^2 \times 100{,}000 \times 1{,}330 \times 9.06 \div 10 \times 10{,}000^2 \times 10^6 =$

$$\frac{10^{15} \times 1{,}330 \times 9.06}{10^{15}} = 12{,}049 \text{ lbs.}$$

The variation in weight occurring through the introduction of a three-phase system suggests the economic reason for its success over other experiments in the same direction. The results show equivalence in weight for a single and two-phase system as stated. The three-phase gives a favorable difference in weight such as that shown by the subtraction of 12,049 lbs. from 16,066 or about 2 tons of copper.

Where three-phase power transmission is a problem of many miles instead of the limited distance of the last examples, a formula is suggested for the pounds weight of copper as follows:

Pounds of Copper $= M^2 \times Kw. \times 300{,}000{,}000 \div p \times E^2$,

where M = the distance of transmission in miles,
Kw. = the total energy delivered in kilowatts.

The power factor is assumed to be approximately 95 per cent.

If, for the purpose of illustrating the application of the formula, the following data is assumed:

M = 100 miles,
Kw. = 10,000,
p = 10,
E = 100,000 volts,

then the weight of copper will equal

$$\frac{100^2 \times 10{,}000 \times 300{,}000{,}000}{10 \times 100{,}000^2} = \frac{10^4 \times 10^4 \times 3 \times 10^8}{10 \times 10^{10}}$$

which $= \dfrac{3 \times 10^{16}}{10^{11}} = 300{,}000$ lbs. of copper.

The Drop in the Line.—This important element must receive consideration as the factor influencing the commercial aspect of the problem of power transmission more than any other. It is, in fact, the question of wasted energy in the line, which governs its cross-section for a given length. The weight is therefore an element governed by distance, only in so far as the energy to be dissipated meets with consideration. The greater the drop the less the weight of copper for a given distance, other things being equal, and the less the drop the greater the weight of copper for a given distance under the same circumstances.

The formula for the volts lost in the power line is as follows:

Volts lost in line = p × E × B ÷ 100, where, as already stated,

p = per cent. loss of power,
E = total pressure of line at the receiving end,
B = 1 for direct current and values for alternating current service, depending upon the size of the wire, frequency of the current and the power factor employed.

As indicated, it is equal to 1 for direct current and where a 100 per cent. power factor is correct for the circuit. In the following tables values are given for wires 18 inches apart. If the difference in phase between the transmitting and receiving end is not very marked, these figures are reliable for values of B. Where the line loss exceeds 20 per cent. and large conductors at 125 cycles are employed the figures will fail. For lower frequencies and less loss they average up correctly; at about 10 per cent. loss the most reliable results may be obtained. With the wires nearer the loss becomes less until, if side by side, only the resistance loss remains:

Values of B.

Size of wire.	60 Cycles. Per cent. Power Factor.				125 Cycles. Per cent. Power Factor.			
	95	90	85	80	95	90	85	80
0000	1.62	1.84	1.99	2.09	2.35	2.86	3.24	3.49
000	1.49	1.66	1.77	1.95	2.08	2.88	2.77	2.94
00	1.34	1.52	1.60	1.66	1.86	2 18	2.4	2.57
0	1.31	1.40	1.46	1.49	1.71	1.96	2.13	2.25
1	1.24	1.30	1.34	1.36	1.56	1.75	1.88	1.97
2	1.18	1 23	1.25	1.26	1.45	1.6	1.7	1.77
3	1.14	1.17	1.18	1.17	1.35	1.46	1.53	1.57
4	1.11	1.12	1.11	1.1	1.27	1.35	1.4	1.43
5	1.08	1.08	1.06	1.04	1.21	1.27	1.3	1.31
6	1.05	1.04	1.02	1.	1.16	1.2	1.21	1.21
7	1.03	1.02	1.	1.	1.12	1.14	1.14	1.13
8	1.02	1.	1.	1.	1.09	1.1	1.09	1.07
9	1.	1.	1.	1.	1.06	1.06	1.04	1.02
10	1.	1.	1.	1.	1.04	1.03	1.	1.

In the following table the value of B for frequencies of 25 and 40 cycles per second are given. Thus the size of wire, the power factor and frequencies of 25, 40, 60 and 125 give an elastic field for choice of data in calculations of power lines.

Values of B.

Size of wire B. & S. Gauge.	Area of wire in circular mils.	Weight of bare wire per 1,000 ft. in lbs.	Resistance of wire per 1000 ft. at 25° C. or 77° Fah. in ohms.	25 Cycles. Per cent. Power Factor.				40 Cycles. Per cent. Power Factor.			
				95	90	85	80	95	90	85	80
0000	212,000	641	0499	1.23	1.29	1.33	1.34	1.52	1.53	1.61	1.67
000	168,000	509	.0628	1.18	1.22	1.24	1.24	1.40	1.41	1.48	1.51
00	133,000	403	.0794	1.14	1.16	1.16	1.16	1.25	1.32	1.35	1.37
0	106,000	320	.0997	1.10	1.11	1.1	1.09	1.19	1.24	1.26	1.26
1	83,500	253	.126	1.07	1.07	1.05	1.03	1.14	1.17	1.18	1.17
2	66,600	202	.159	1.05	1.04	1.02	1.	1.11	1.12	1.12	1.10
3	52,400	159	.202	1.03	1.02	1.	1.	1.07	1.08	1.07	1.05
4	41,600	126	.254	1.02	1.	1.	1.	1.05	1.06	1.03	1.
5	33,100	100	.319	1.	1.	1.	1.	1.03	1.01	1.	1.
6	26,200	79.5	.403	1.	1.	1.	1.	1.02	1.	1.	1.
7	20,700	62.8	.510	1.	1.	1.	1.	1.01	1.	1.	1.
8	16,600	50.4	.635	1.	1.	1.	1.	1.	1.	1.	1.
9	13,000	39.4	.813	1.	1.	1.	1.	1.	1.	1.	1.
10	10,400	31.5	1.01	1.	1.	1.	1.	1.	1.	1.	1.

The above table is reliable with respect to certain assumed conditions of practice. The assumption of conditions can be crystallized in actual construction by making general allowance of, say, a power factor of 95 per cent for incandescent lighting and synchronous motors; 85 per cent. for induction motors and lighting done together, and for induction motors alone about 80 per cent. The value of p in the previous calculations is the percentage of delivered power lost, not the percentage of loss in the generator. The potential E is the pressure at the receiving end of the power line.

THE FUTURE SUPPLY OF INDIA-RUBBER.*

BY H. L. TERRY, F.I.C., A.I.M.M.

That the present high price of india-rubber is a matter of concern to manufacturers and users alike needs no emphasis, and it would be quite superfluous to enlarge upon it. With regard to the future, however, we are largely in the region of hypothesis, and in the presence of such divergent statements as we have made by this or that authority, it is permissible to attempt to review the situation in a concise manner for the benefit of those who may be interested, but whose leisure or technical knowledge does not permit them to undertake the task for themselves. If we put rubber artificially produced by the chemist aside as not coming within the pale of practical politics—whatever may be looked for in the dim and distant future—there are only two sources of supply which come up for serious consideration. One of these is, of course, what nature has provided with a lavish hand in the tropical and sub-tropical regions of our globe; the other the product of the plantations which in rapidly increasing numbers are to be found in Ceylon, the Straits Settlements, Mexico, Central America, etc. It needs no great discernment of mind to see that the interests of those supplying rubber from plantations and from untended nature are not identical, and it behooves us therefore to weigh carefully the arguments put forth by interested persons as to where we must look for the rubber of the future. More especially is this cautionary measure necessitated, owing to the fact that joint stock enterprise is rapidly taking the place of individual effort, and it is quite conceivable that the investing public, as a whole, knows no more about the intricacies of the rubber trade than it does about the stopes and cross-cuts of its gold-mining ventures. Now, in writing about rubber plantations to-day, one is in a very different position to 30, I might in truth say, 10 years ago. What was at one time entirely experimental and gained for its initiators the title of faddists, is now a demonstrated fact, and those who loudly predicted failure have been effectively silenced. This, however, is not the same as saying that financial success is assured for all time, as some would have it, and it will be advisable, therefore, to look into the general situation somewhat closely.

The bulk of the supplies of raw rubber comes to the world's factories from Brazil and the Congo region, the main point with regard to future supplies being that in Brazil. The product is obtained by merely tapping the trees without affecting their vitality, while in Africa the tree, which is a kind of creeper, is cut down and destroyed in the gathering process. It will be recognized then that without replanting it is only a matter of time for total exhaustion in the principal yielding grounds of West Africa; on the other hand, the Hevea braziliensis, which may be named as a typical South American tree, continues to yield year by year, thus requiring practically no oversight or capital outlay. That there is still plenty of this Brazilian rubber, which is of a much higher quality than the African, to be had for the gathering admits of no doubt. The difficulty is to get sufficient labor to gather it in order to keep up with the constantly increasing demand. There can be little doubt that if an unlimited supply of acclimatized labor were available, we should soon see a decline in the high prices now ruling. Mr. Samuel Colt, an American authority, expresses the opinion that American enterprise will, before long, put the raw rubber supply straight as it has overcome in the past other threatened dangers. Still, as far as I am aware, Mr. Colt does not go beyond indicating the road by which we must expect deliverance; he gives no sort of guarantee that the obstacles in the path will be removed in the near future, and it is this absence of more than a hopeful feeling that is buoying up the hopes of those who are investing their money in growing Para rubber in countries where the labor question is not likely to become acute. Of course, progress has been made in augmenting the Brazilian output. It has only taken five years to show a rise from twenty-two thousand tons to thirty thousand tons. Still, there is room for a much greater production, and in face of the limited numbers of the Seringuer, or who can withstand the deadly miasmatic swamps of Brazil, it is a matter of the first importance for present and prospective planters to know if there is any reasonable prospect of Mr. Colt's optimistic forecasts being fulfilled. Not that the planters regard the issue with fear and trembling, for, to judge from some reports which have recently been made public, they are prepared to witness a very considerable reduction in the present selling price with equanimity. Though it is still rather early to arrive at a correct estimate of the profits of rubber planting, it appears to be the fact that, given favorable conditions, the Para rubber tree can be grown in Ceylon and the Straits Settlements at a cost of 2s. per pound of pure rubber. Indeed, one authority gives it as his experience that it can be grown for 1s. 2d. per pound, but this has not, I understand, found general corroboration. Supposing, therefore, that we take the higher figure of cost, it is clear that at the present selling price of Para rubber (5s. 7d. per pound) the profits are very large. Plantation-grown rubber, we may say, fetches a higher price in the market than the product of Brazil on account of its freedom from water. There does not seem to be any ground to suppose that it is intrinsically superior, though some aver that it is. On the contrary, it is quite probable that, owing to the tapping of immature trees, or the effect of climatic conditions which differ from those in Brazil, deterioration may show itself. At present the preparation of the rubber from the latex or milk, is carried out on the plantations under more skillful management than is the case in Brazil, where the gatherers are under no scientific supervision. It is this careful preparation of plantation rubber, and its consequent purity, that has attracted the manufacturers' attention. As I have said, there is no reason to suppose that it is in any way superior to the wild product, and it would seem that any difference is more likely to be on the side of inferiority arising from circumstances, which are as yet but incompletely understood. For instance, the nature of the soil has a good deal to do with the yield of rubber and its quality, and in this connection I am informed by those who know Ceylon well that a good deal of rubber planting is now going on in localities where the soil is quite unsuitable. The tree may grow well enough but will yield rubber deficient in quantity and quality on arriving at maturity. This point, among others, is one which should engage the attention of those whose financial co-operation is invited for the numerous schemes in existence or in process of development. This, however, is only by way of a warning note that, though considerable progress has been made in rubber growing, there are still possible disappointments in store for those who invest even in reputable concerns.

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*From the "Electrical Review," London.

That plantations laid out on scientific lines, and under good management, will yield a very handsome profit to those who are content to wait seven or eight years for a return upon their capital certainly now seems to be a demonstrated fact, and investors who take the trouble to discriminate between the good and bad schemes brought before their notice should be under no anxiety as to their money. I refer to the necessity of discrimination, because there will undoubtedly in the future, as in the past, be propositions put forward which have but very slight prospects of success, even if such a strong appellation as swindle cannot fairly be used in connection with them.

To revert now to the all-important matter, the selling price, even if a considerable reduction were experienced, it is clear that, at the proved cost of production, a good margin of profit will be available.

Suppose that Mr. Colt's prognostication of American push and energy were realized, and that Brazil yielded up an increased amount of her latent rubber, there is the continually increasing demand to set against this. Except for such purposes as motor tires, where the best rubber is imperative, there is no doubt that the trade is being hindered in its development in other directions by the high prices now ruling. Should a fall, therefore, take place, we should undoubtedly see the demand increase, which would mean a bigger turnover at reduced profits for the planters. On the whole, therefore, although I see no immediate prospect of any fall in price, it is clear that this eventuality can be faced with composure by the planters, provided, of course, that the stated cost of production is strictly accurate and not liable to any increase. A statement recently made at the Colonial Institute, to the effect that rubber planting will yield wealth beyond the dreams of avarice, must, in the light of our present knowledge, be received with a certain amount of caution, but that the outlook for those who get into reputable concerns at first hand is distinctly bright, is an assertion that can be made in all confidence and sincerity.

I have spoken chiefly of Para rubber because it is the planting of this sort which is attracting the greatest attention at the present time. In Mexico and Central America, however, the indigenous tree, the Castilloa, is being extensively planted, and there is no good reason to doubt of satisfactory results being obtained. In this connection it may not be superfluous to say a word as to relative quality. The product of the Castilloa trees is a good rubber, and under cultivation it will, doubtless, command higher values in the market than it has done in the past when prepared by the natives without supervision. At the same time there is no ground for supposing that this rubber will equal Para rubber in price as has been asserted in connection with the flotation of some companies. Exaggerated statements of this sort ought to be refuted as soon as possible, as they can only have the ultimate result of bringing discredit upon the rubber-planting movement generally.

In this brief survey many points of interest have had perforce to be ignored, and not the least of these is the question as to how far the existing high prices are the result of "opportunism" on the part of the importers and brokers. At present the amount of rubber from cultivated sources is not great enough to cause perturbation in the brokers' camps, but without going so far as to predict anything of the sort, one can imagine the occurrence of such a conflict between the producing interests of Brazil and Ceylon which might result in a material drop in prices.

EMERGENCY VALVES.

BY W. H. WAKEMAN.

ARTICLE II.

Although many devices in steam plants that are operated by hand are valuable and do good work, the tendency in all departments is to use automatic appliances as far as practical. A damper in the stack is useful and efficient when constantly watched and operated by hand, so that best results are often secured from it, but it requires the attention of one man almost constantly to do this, therefore it is much better in every way to install an automatic damper regulator which will always be on duty at no expense except the first cost.

Applying this principle to emergency valves, we find it better in many cases to have one that will close automatically, in case of accident requiring it, than to wait for the engineer (or somebody else) to discover the trouble and operate the required device by hand.

Fig. 5 illustrates a valve that is closed instantly in case of accident to the boiler to which it is attached, which causes steam to rush from the header back into the boiler. If a steam pipe bursts, allowing steam to pass into the atmosphere at a very rapid rate, the valve is closed by boiler pressure acting on it.

This valve is now closed, but when steam pressure in the boiler equals or slightly exceeds that in the header it passes through 2 and 3 raising the valve 4 for this purpose. A plunger operates in the dashpot 5 to prevent violent action of the valve, which would injure or destroy it; 6 is a continuation of the valve stem, which in this case is made in three parts. It carries the wheel 7, by means of which the valve is closed by hand whenever necessary; 8 is a steam pipe connection, by means of which pressure is admitted to close the valve, and 9 allows steam to pass to the atmosphere. When pressure accumulates in 10 it acts on the face of the piston, carrying the stem 11 down with it, provided there is little or no pressure in 12.

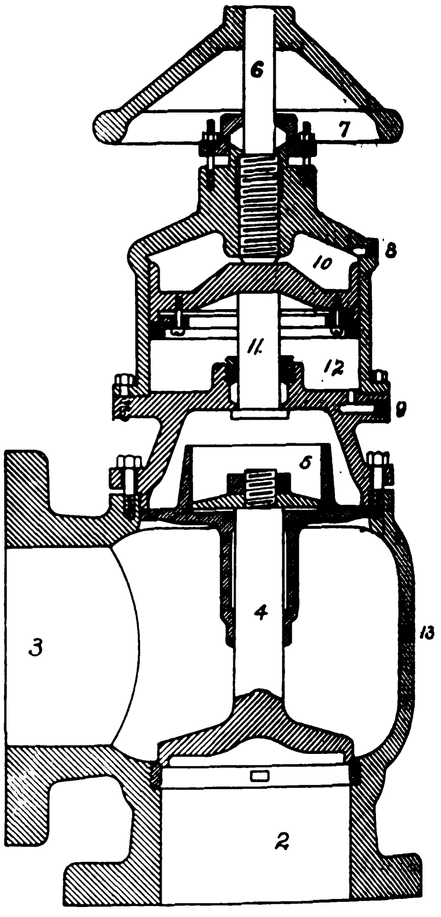


FIG. 5.

The piston carried by 11 is larger than the valve 4, therefore the total pressure on it is greater, making it close quickly. The device which admits steam automatically under given conditions will be presented later on.

Fig. 6 is another emergency valve with special features. Steam passes through 2 and 3 raising the valve 4 for this purpose, but before accomplishing this it must overcome the force exerted by a stout spiral spring, as shown; 5 is only an exhaust chamber, as no dashpot is needed where a spring is employed; 6 is the stem and 7 the wheel, as in previous illustrations. Steam is admitted at 8 to close the valve, while 9 allows steam or water that may have leaked through from 10 to escape, thus preventing pressure from accumulating at this point where it is not needed.

The appliance which admits steam automatically to the valves, shown in Figs. 5 and 6, is called a pilot valve. It is illustrated in Fig. 7. A spiral spring 2 is adjusted to operate against any desired pressure, and when so adjusted it holds a valve ready to open when required. Steam from the boiler enters the pipe 3 but can go no further under normal conditions. The small pipe 4 is connected to 13 in either Fig. 5 or 6, admitting steam from the main valve in either case to the diaphragm 5, Fig. 7, and so long as full pressure is maintained here the whole remains inoperative, but in case a steam pipe bursts, or the engine races badly, pressure in the header will be reduced by the rapid flow of steam. As soon as the pressure is lowered at 5 it can no longer resist the tension of spring 2, hence it at once opens a valve which admits steam from the boiler coming through 3 and passing out at 6 into 8 in Fig. 5 and 6, and as it here operates on a piston, which is larger in diameter than the main valve 4 below it, in both cases the flow of steam in either direction is immediately cut off.

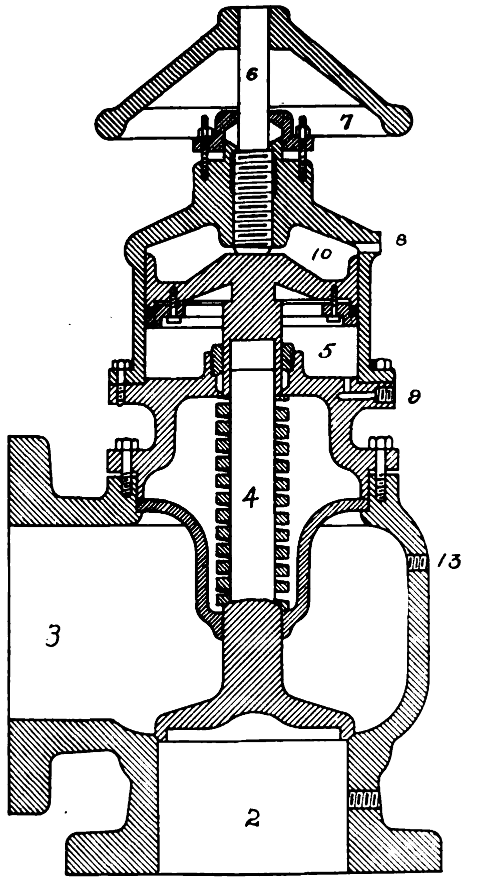
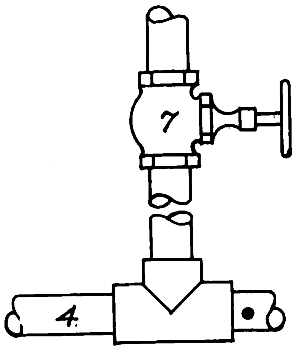


Fig. 6.

The valve 7, Fig. 7, is for the purpose of trying the apparatus at any time to show that it is in good working order, for when this valve is opened it lowers the pressure at 5 causing the main valve to be closed as above described.

The operation of a valve fitted with a spiral spring, see Fig. 6, and the purpose of its use, needs special mention as interesting principles are involved. Suppose that this spring is strong enough to resist 25 pounds pressure per square inch acting on the face of the valve. Assume that there is no pressure either in the boiler or in the header. In this case there must be a trifle more than 25 pounds at 2 before any steam will pass into 3. This difference in pressure will always exist under fair conditions, regardless of the boiler pressure.



This naturally leads to an inquiry concerning the object sought in generating steam at a high pressure and then reducing it for use in the engine. It is a well-known fact that superheated steam is much more efficient in the cylinder of an engine than a mixture of steam and water, such as we get when a boiler primes. Priming and foaming should not be taken to mean the same thing in this connection, as they do not, for priming may go on every hour that the boiler is used without attracting special attention, for it consists of fine particles of water suspended in the steam and carried over with it to the engine.

If this mixture at 125 pounds pressure comes through 2 meeting the valve 4 which reduces the pressure to 100 pounds, the same amount of heat is contained in each pound weight of steam at the lower pressure in 3 that was present when it left the boiler, but it appears in different form.

Under natural conditions the temperature of steam corresponds to its pressure, therefore if the latter is 125 pounds by the gauge the temperature is 352 degrees. As this passes through the valve and is reduced to 100 pounds, it is not changed to 338 degrees, which is the corresponding temperature, except in some special cases, because there is nothing provided to absorb this heat, therefore it passes through the valve.

The form it takes after this passage will depend on the condition of steam as generated. If it contains no water in suspension, the difference between the two temperatures above mentioned, or 352 — 338 = 14 degrees goes to superheat the steam. If we now proceed to take one pound in weight of the steam just passing and consider the resulting action, it will simplify matters as we shall then have fourteen heat units as the basis for calculation.

When considering this matter it is well to remember that a heat unit is the amount of heat required to raise one pound of water one degree in temperature, also that the specific heat of steam is the amount of heat required to raise one pound of steam one degree, taking a heat unit as a basis for comparison.

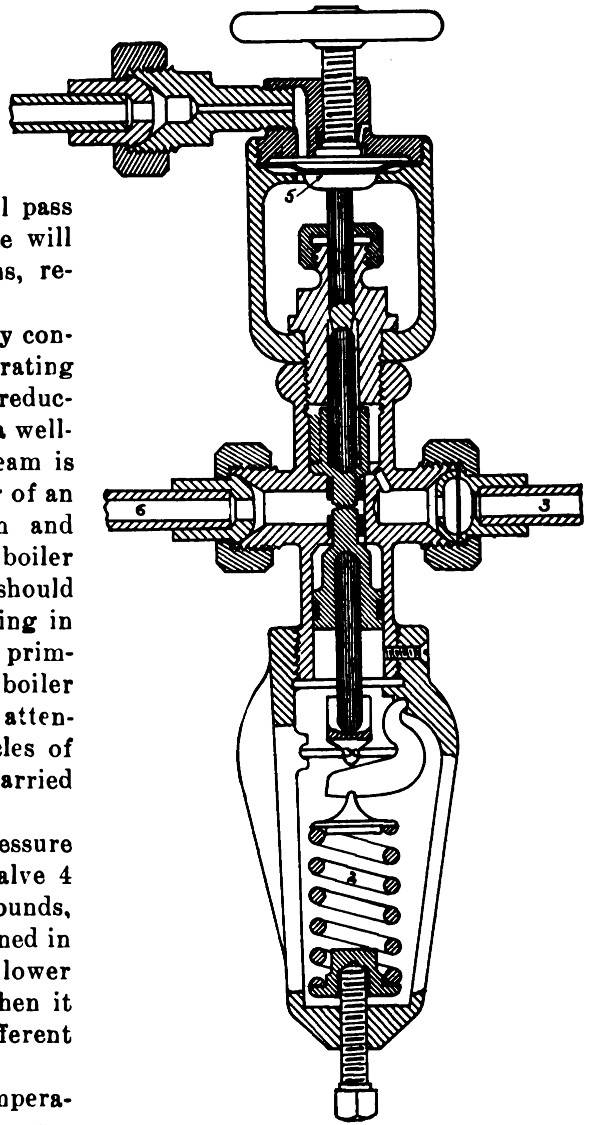


Fig. 7.

Now the specific heat of steam is practically .5, therefore every heat unit that passes the valve, above the natural heat of steam at the reduced pressure raises one pound of the latter two degrees. Taking this into consideration we see that steam after passing the valve has a temperature of 338 + (14 × 2) = 366 degrees, provided none is lost by radiation.

Steam as it comes to the valve may contain water as before mentioned, in which case the fourteen heat units will be utilized in evaporating this water, delivering drier steam to the engine than would otherwise be secured.

If these fourteen heat units are just sufficient to evaporate this water then the steam at reduced pressure will have a temperature of 338 degrees, which constitutes one of the special cases above referred to.

In these calculations fractions are omitted as the results thus obtained are sufficiently accurate to serve as illustrations.

The spiral spring in Fig. 6 makes it impossible for steam to pass into the boiler under any conditions.

WRINKLES.*

EDITED BY H. C. ABELL.

Method of Using One Telephone on Two Floors.

Several years ago our company was paying for two telephones, one up-stairs and one down-stairs. During the daytime the down-stairs telephone was seldom used. I made a box extending from the first floor to the second floor, and in this box I placed the up-stairs telephone, arranging it so it could be raised or lowered something like a dumb-waiter. The telephone wires were connected to two brass rods, which extended from the first to the second floor in the box, and connection was made from these rods to the telephone through sliding contacts which were open-arc lamp carbon brushes. A counter weight was attached. During the daytime the telephone would be at the top, and used in the office on the second floor. At night the telephone would be pulled down-stairs and used there. This has been used for a number of years, and saves the company $75 a year.

F. ELLWOOD SMITH,
Somerville, Mass.

Signal Device for Long-Distance Transmissions.

In long-distance transmission work it is essential that the power house and substation should always be in communication, the one with the other. Experience has taught us that the telephone is not always reliable, so a signal device has been arranged in order that in the event of one of the telephone lines being down the operators in the power house and substation can exchange messages by using a code of signals. The sketch of connections herewith will probably make this clear to your readers.

At the substation end there is a small single-phase induction motor direct connected to a direct current generator, .25 kw. capacity, wound for 110 volts, as shown by A in diagram. The terminals of this generator are connected to ground and to binding post 1 of telegraph relay B. As shown in detail drawing of B, this binding post is connected through the relay coils n and o in series, to the two coils m and p, which are connected to the line terminals 2 and 3. Binding posts 4 and 5 are connected to the local gong circuit. We have the same arrangement at the hydraulic station, except that the binding post 1 of relay is connected straight to ground through contact a^1, forming return circuit to generator A.

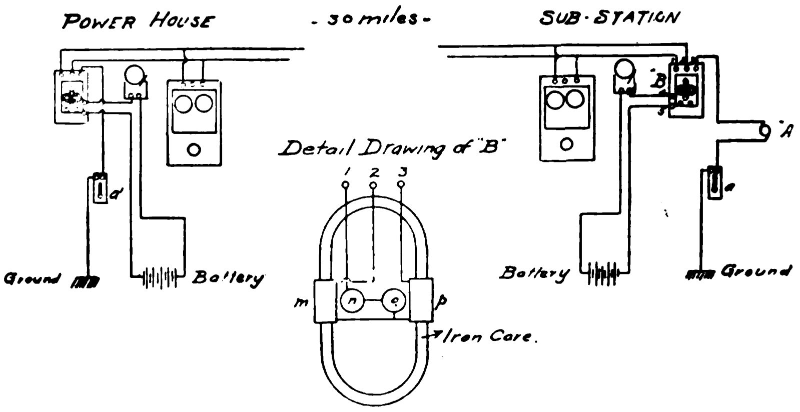


DIAGRAM.

When contacts a and a^1 are closed causing current to pass through the coils of relays, the magnets are attracted, and hold lever arm of relay down. If the operator in the substation or power house wants to signal he opens the ground circuit at a or a^1. The magnets then release the relay arm, which, in turn, short-circuits binding posts 4 and 5, thus closing the local gong circuit. As long as either of these contacts a or a^1 are open the bell will continue to ring. By combinations of short and long rings, corresponding to dots and dashes, we have arranged a code of signals that answers the purpose very well when we have trouble with the telephone.

G. A. MONTGOMERY, Montgomery, Ala.

Telephone Signal.

It is not always possible, when there is much noise in a station to hear the telephone bell, so a central station drop has been arranged in shunt with the telephone box. When the drop is down a circuit with a red lamp is completed. By making the proper arrangement when the drop is down, the drop-ringer is thrown out of circuit and the telephone is thrown in.

H. C. GRAY.

Inductive Effect on Telephone Line in Long-Distance Transmission Work.

We have experienced considerable trouble on our private telephone line between the substation and the power house.

Originally the line was run on brackets spaced about 6 feet below the transmission line, with running transposition between every two poles. The wire on top at one transposition would be under at the next. At times it was very difficult to hear any conversation over the line. This trouble was remedied to a large extent by running the line on two-pin cross-arms and transposing at every fourth pole. The transposition was made on an insulator for that purpose, first on one side of the line end then on the other. The wire that was above the other at the first transposition is always kept on top. That is, every time the line is transposed we find the same wire on the upper groove of the insulator. This method of transposition was found to be a big improvement over the old method, as we can now hear very distinctly over the new line.

A. L. LOWRIE,
Montgomery, Ala.

Brushing Horses by Electricity.

The great agricultural exhibition which is being held in Munich this summer is one of the most representative shows which has ever been organized in Germany, says a foreign paper. The most up-to-date inventions and machinery are to be seen in every department, and quite one of the most interesting has its place among the veterinary exhibits, where equine health and comfort are lavishly catered for by a well-known Berlin firm. Here your horse can have its coat brushed by electricity. This is done by means of an inclosed revolving brush on the same system as the patent sweepers used for carpets. It is, however, worked by an electric current and thoroughly cleanses the animal's coat of all dust and dirt in less than a quarter of the time employed in the old method.

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*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

BRITISH SCIENTISTS IN SOUTH AFRICA.

(From our London Correspondent.)

On July 22 and 29 there sailed from England bound for Cape Town a large number of scientists and engineers for the annual meetings of the British Association for the Advancement of Science.

The Congress will open with the first part of Prof. G. H. Darwin's presidential address at Cape Town on August 16. The meetings will continue at Johannesburg and Durban. The second half of the president's address will be delivered at Johannesburg on August 28, the subject being "Evolution." Several days will be devoted to the reading of papers and lectures at each place, and the following are some of the electrical topics which are to be discussed:

There will be a lecture by Prof. W. E. Ayrton, of London, on "Distribution of Power;" one by Sir William Crookes on "Diamonds;" and one by Prof. Porter, of McGill University, Montreal, on "The Bearing of Engineering on Mining." The papers promised include:

"To What Extent Can the Ether Affect the Motion of Matter?" by Prof. Larmor.

"Radiation at Low Temperatures," by Dr. J. T. Bottomley.

"The Leak of Electricity from Certain Heated Substances," by Prof. Beattie.

"Observations of Atmospheric Electricity in South Africa," by Dr. J. T. Bottomley and Mr. Lyle.

"The Teaching of Elementary Mathematics" (discussion) and "The Teaching of Elementary Mechanics" (paper by Prof. Perry).

"The Experimental Foundation of the Theory of Heat Conduction," by Dr. C. H. Lees.

"Magnetic Survey of South Africa" and "Electrical Conductivity in Relation to Chemical Action," by Prof. Beattie.

"Form of Dry Daniell Cell," by Mr. J. Brown.

"On Flight," by Prof. G. H. Bryan.

In the proceedings of the Engineering Section no large space will be given to electrical matters. Mining will naturally be the chief subject, and irrigation will be the text of Sir Colin Scott Moncrieff's presidential address to the section. Roller bearings, automobiles, turbines and the new railway bridge over the Zambezi at Victoria Falls are in the list of topics.

The Victoria Falls, whose utilization for electrical transmission is one of the great works which will be soon undertaken in connection with the development of South Africa, will be visited by large parties of the British visitors. The reading of papers and traveling about from place to place are expected to occupy some 35 days or thereabouts, and the voyage out from England and home again makes a total of 70 days.

The number of visitors from English shores is about 400. Members of the South African Association for the Advancement of Science will join them in the proccedings.

Proposals Invited.

Sealed proposals are invited until September 30 for furnishing all material, labor and other appliances, and erecting and putting in operation, in a building and foundations to be provided by the United States, a complete heating, lighting and power plant, including machinery, boilers, piping, electrical transmission, cables and conduit, appliances and all other equipment in said building. The necessary plans showing the general layout, and complete information and specifications, will be furnished responsible intending bidders on receipt of a certified check for $50, payable to the order of Elliott Woods, superintendent United States Capitol, Washington, D. C.

The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until August 22 for furnishing Eastern Navy Yards with the following electrical material: Schedule 62, incandescent lamps, carbons, insulating tape, wire, lamp cord, testing set, wattmeters and miscellaneous electrical supplies; schedule 63, generating set, wire, cable, cells, electrical supplies; schedule 64, conductor cable, testing magnetos, supply boxes. Blank proposals can be obtained at the Navy Pay Office in New York or on application to the Bureau at Washington. The Bureau is also inviting sealed proposals until September 5 for furnishing the Mare Island and Puget Sound, Wash., Navy Yards with the following: Schedule 58, dry cells, insulators, generating sets. Blank propssals will be furnished on application to the Bureau. On August 29 the Bureau will open bids for furnishing the Pensacola Navy Yard with the following: Schedule 69, electrical supplies; schedule 70, incandescent lamps. Blank proposals can be obtained on application to the Bureau,

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 1, 1905.

Electric Railways and Appliances.

796,188. Trolley-Wheel Bushing. Fred M. Carroll New Haven, Conn., assignor to the H. B. Ives Company, same place. Filed March 20, 1905.

Electric Lights and Appliances.

795,867. Electric Hand-Lamp. Herman F. Stakelbeck Philadelphia, Pa. Filed Dec. 16, 1904.

Electrical Machinery and Apparatus.

795,838. Asynchronous Electric Motor. Paul Jigouzo Vanves, France. Filed Dec. 1, 1902.

795,861. Alternating-Current Induction Motor. Leo Schuler, St. Louis, Mo. Filed July 16, 1904.

795,862. Power Transmission in Self-Propelled Vehicles or Vessels. Charles S. Schultz, London, Eng. Filed Jan. 15, 1904.

795,888. Attachment for Transmitters. Sidney A. Beyland, Elyria, O., assignor to the Dean Electric Company, same place. Filed July 20, 1904.

795,958. Controller for Electric Circuits. Fred Cedergren, Chicago, Ill., assignor of one-half to Frank S. Betz, same place. Filed Dec. 17, 1904.

796,031 to 796,069. Electrical Measuring Instrument Electric Meter, Meter, Indicating Instrument, Automatic Switch for Storage Batteries and Three-Wire Meter. Thomas Duncan, Chicago, Ill., and Lafayette, Ind. First patent filed June 26, 1901. Last renewal Jan. 7, 1905.

796,100. Electric Cable. Charles E. Wilson, Philadelphia, Pa. Filed April 8, 1903.

796,360. Electric Switch. Joseph H. Rusby, Nutley, N. J. Filed June 1, 1904.

796,368. Motor-Meter. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company. Filed Nov. 21, 1896.

Telephones and Telephone Apparatus.

795,872. Telephone-Exchange. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, same place. Filed Nov. 16, 1904.

795,961. Telephone-Exchange System. Elmer R. Corwin, Chicago, Ill. Filed Sept. 3, 1904.

796,022. Cut-out for Telephones. John A. Tornquist, Clinton, Ia., assignor to the Tornquist Electrical Manufacturing Company, Davenport, Ia. Filed Oct. 6, 1904.

796,089. Telephone-Exchange Apparatus. Elias E. Ries, New York City. Filed May 20, 1904.

Miscellaneous.

795,820. System for the Selection of Electric Circuits. Anson G. Cox, Boston, Mass., assignor to Spencer W. Richardson and Richard P. Elliott, trustees. Filed Jan. 27, 1902.

795,821. Underground Conduit. Henry T. Craven, Vineland, N. J. Filed May 24, 1904.

795,836. Selective Call Apparatus. John A. Hulit, Topeka, Kan. Filed Sept. 3, 1904.

795,843. Syntonic Space Telegraphy. Oliver J. Lodge, Birmingham, and Alexander Muirhead, Shortlands, Eng. Filed March 21, 1902.

795,851. System for Selecting Electrical Circuits. Albert D. Neal, South Boston, Mass., assignor to Spencer W. Richardson and Richard P. Elliott, trustees Filed Oct. 18, 1901.

795,852. Electrical Relay. Albert D. Neal, South Boston, Mass.; Emily S. Neal administratrix of said Albert D. Neal, deceased. Filed March 4, 1902.

795,857. Method and Means of Signaling. Frank W. Prentice, Braddock, Pa., assignor, by direct and mesne assignments, of one-half to H. C. Rehn, Cleveland, O., and George D. Breck, Pittsburg, Pa. Filed Nov. 19, 1902.

795,887. Electrolytically Refining Silver. Anson G. Betts, Troy, N. Y. Filed March 8, 1905.

795,956. Process of Electrically Heating Water and Other Liquids. Eugene A. Byrnes, Washington, D. C. Filed Dec. 10, 1904.

796,011-012. Apparatus for and Method of Electrostatic Separation. Greenleaf W. Pickard, Boston, Mass., assignor to Charles Henry Huff, Brockton, Mass. Filed Aug. 2 and Nov. 12, 1904.

796,114. Electrotherapeutic Apparatus. Herschel E. Currey, Baker City, Ore Filed June 14, 1905.

796,241. Electrically-Energized Fence. Albert D. McNair, Dallas, Tex. Filed Nov. 4, 1904.

796,259. Electromagnetically-Operated Reciprocating Tool. Harry S. Sherman, Denver, Col, Filed April 22, 1904.

796,349. Electrical Ignition Apparatus for Internal-Combustion Engines. Arthur J. Postans, South Kensington, Eng. Filed Oct. 19, 1903.

796,403. Electric-Wave-Telegraph Receiver. Charles L. Fortier, Milwaukee, Wis. Filed April 17, 1903.

THE TELEPHONE WORLD.

Good Financial Report for Indèpendent Company.

The recently issued financial statement of the Monmouth, Ill., Independent Telephone Company shows a very creditable financial year. In addition to paying in full the current expenses of the year, the company has paid interest on bonds amounting to $1,482, and has created a sinking fund for the redemption of the bonds, in which there has been deposited $948.48, out of which six treasury bonds have been redeemed and canceled.

The report shows a gain of $1,778.50 in the amount of receipts over those of last year, or a gain of $1,376.51, equal to 16½ per cent. in the rent receipts, and a gain of $358.05 in the toll receipts, equal to 21¼ per cent.

A toll line is being built to Burlington which will be complete by the last of the summer. Last year 998 telephones were being operated. This year 1,181 are in operation, net gain of 183—166 in the city and 17 in the country. There are 877 subscribers in the city, 188 of these being in offices and 689 residences. There are 304 county subscribers.

Farmers to Build Telephone Line.

Farmers and business men in the northwestern section of Lancaster County, Pa., have organized the Mastersonville Telephone Company, which will operate an Independent line through three or four townships and extend into Lebanon County. The headquarters will be at Mastersonville. Several hundred subscribers, principally farmers, have been secured. This is the third Independent telephone line to be established in that county by the farming interests and all of them are proving profitable investments.

With the completion of the Independent telephone system in Council Bluffs, the Independent companies will secure connection from Iowa to Nebraska, which will allow them to compete on heretofore Bell territory. The Iowa lines have been built within a few miles of Council Bluffs, but there they were forced to stop, and no interstate connections with Nebraska have been possible on account of this seemingly insignificant gap.

S. H. Woodson, president of the Independence, Mo., Home Telephone Company, has denied the rumor published in an Independence paper that his company had sold the plant to the Bell telephone interests. He said that no negotiations were on with the Bell people and that the plant would never be sold to that company.

Charles R. Lackey and John S. Lawrence have purchased the Globe Telephone Company's franchise, wires, etc., at Cadiz, Ky., and will install a new plant without delay. The telephone plant at Cadiz was destroyed by fire several months ago, and since that time Cadiz has been without the use of telephones.

Directors of the Norman County, Minn., Telephone Company are contemplating the purchase of the Ada, Halstad, Shelly and Twin Valley lines. The Iron Range Company has offered these lines for $9,000. Another meeting of the former company will be held, when something definite will be decided.

Keystone Telephone Company's Plans.

Elaborate plans are contemplated by the Keystone Telephone Company for the rapid extension of its system throughout Philadelphia, Pa. The improvements have been made possible through the fact that the company has available cash assets of $750,000, the balance of the recent issue of $4,000,000 first mortgage 5 per cent. gold bonds, by which the company's whole floating indebtedness was cleared off.

Already the work of laying conduits and installing cables has been begun in the northwestern part of that city, representing a territory which the company hitherto has not penetrated. It is estimated that the total cost of the work will be about $125,000.

The company proposes also to extend its system in West Philadelphia, and toward that end has already begun enlargement of its West Philadelphia switchboards and service lines at a probable cost of $30,000. The company now owns six telephone exchange buildings, having an ultimate switchboard capacity of 24,200 lines, of which capacity 16,520 lines have been installed, that serve more than 17,000 telephones. Its present conduit system, located in 229 miles of streets, has a total capacity of 10,522,454 duct feet, and is now being added to daily.

The local telephone company of Humboldt, Neb., is having a number of new cables put in through the business section of that city, as the service has extended to such limits that the poles are unable to bear the weight of additional wires needed. The system is being practically rebuilt.

The members of the Belvidere, Ill., Telephone Company, who some time ago signified their intention of rebuilding the entire system, have commenced work, and when finished will have that city equipped with one of the most up-to-date systems in that section.

Recent news from Doylestown, Pa., states that residents of Nockamixon Township have formed a telephone company with the following officers: President, William C. Ealer; secretary, Thomas L. Henry; treasurer, T. M. Moyer; agent, Dr. G. F. Grim.

Articles of incorporation of the Hickman, Neb., Telephone Company were lately filed with the county clerk. The incorporators are: Adam Brendle, J. F. Judah, C. L. Morrison, Henry Diesel, A. E. VanBurg, E. B. Sinker, R. H. Sawyer, Charles H. Hempel and August Schmutte. The capital stock is fixed at $6,000.

The Red Line Mutual Telephone Company of Kansas has accepted the incorporation laws of Nebraska and filed an acknowledgment of the same with the Secretary of State.

The action of the common council of Auburn, N. Y., in turning down the proposition of the Empire Telephone Company, indicates that the subway, which is very much needed, will be constructed by the city.

There are now 37,664 telephones in Kansas, an increase of almost 10,000 in a year.

Independent Company Busy.

The Atlantic Telephone Company, recently organized under the laws of the State of New York, has a present capital of $5,000,000. Its authorized capital is $25,000,000, and the directors of the company have also authorized the issuing of bonds to the amount of $15,000,000. All of the financial plans of the company have been perfected. It is the intention of the company to install an Independent telephone system in Greater New York, and to connect this system with the other Independent companies of the country.

One of the directors of the company said that there was little doubt of the company being granted a franchise. He stated that the company had at present contracts for 75,000 telephones in New York City. The rates for interborough connection will be 5 cents a call, and the company will install 'phones without any guarantee from the subscriber. It also offers to furnish unlimited service in residences for $66 a year, and unlimited business service for business purposes $108 per year.

According to the authority above quoted, the company hopes to install 200,000 telephones in Greater New York, and of these it is stated that 50,000 will be in Brooklyn. The company controls an automatic telephone device which does away with telephone operators and has been found very successful throughout the West. It is planned to establish about 20 central stations in Greater New York and of these five will be in Brooklyn.

Telephone Lines for Rural Districts.

That the farmers of Wicomico County, Md., are progressive, has been shown by the business-like manner in which they have taken up the proposition of the Diamond State Telephone Company to give country subscribers telephone service. This movement on the part of the telephone company is meeting with the hearty approval of the merchants of Salisbury as well as the residents of the rural districts, as it places the farmer and the city merchant in close communication with each other, and enables the farmer to transact his business in town over the wires when he is too busy to drive in, and in this way saving him considerable time.

Although the farmers have long realized the value of telephone service, it has been almost impossible for them to have telephones in their residences, owing to the high rate which the company was obliged to charge for a single party line to a country subscriber. But a new system of rates has been arranged by which a country subscriber can be connected on a party line, and the annual rate is divided equally among the number of subscribers on the line, the rate depending entirely on the number of miles that the line is extended from the nearest central office. This brings telephone service within the reach of every farmer.

The Washtenaw Home Telephone Company has opened its new exchange in Ypsilanti, Mich., using the signal battery light system and the automatic cut-off.

The Cameron, W. Va., Telephone Company is to extend its lines to Moundsville.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Alexandria, Pa.—This place is to have electric lights, the borough having granted a franchise to Wallace Wilson and his associates to erect the necessary poles and string the wires to carry their current for electric lighting and power. The same company will furnish electric light and power to Petersburg. Tyrone capital is interested in the enterprise.

Ashland, Ore.—This city has voted to issue $50,000 of bonds for an electric light plant.

Bellefontaine, O.—This city is equipping a new electric light plant.

Clarksville, Tenn.—The Consumers' Electric Light & Power Company has applied for a franchise to construct an electric light and power plant.

Decorah, Ia.—A special election will be held here August 15, to vote on the granting of a franchise to the Decorah Electric Light Company.

Ensley, Ala.—About 80 of the leading citizens met in a recent mass meeting at the city hall, and voted unanimously for the erection of an electric lighting plant by the city.

Escanaba, Mich.—The municipal electric lighting plant has again been made an issue here. Some $70,000 has been put into the venture, but the plant continues to lose money.

Grand Rapids, Mich.—The city authorities have been requested to open negotiations for the lease of the municipal electric lighting plant to a syndicate of Eastern capitalists.

Manito, Ill.—There is some talk of having an electric light plant here. A promoter has recently been here looking into the matter.

Matthews, Ind.—Charles Sampson will install an electric light plant here.

Olympia, Wash.—Negotiations have been started between the State Board of Control and the Northwest Gas & Electric Company of Walla Walla for supplying the State penitentiary with light and power.

Racine, Wis.—The common council has abandoned the plan of building a municipal electric light plant, and decided to enter into a five-year contract with the Milwaukee Electric Railway Company for street lighting.

Reading, Pa.—On August 17 application will be made to Governor Pennypacker by Wagner Leidy for a charter for the incorporation of a new company to be known as the Cumru Township Electric Light, Heat & Power Company. The incorporators named in the application are William F. Krick, Henry H. Vose and George W. Wagner. The plant will be located at Sinking Spring, and feed wires will be erected to Shillington and vicinity. Work will be commenced as soon as the charter is granted.

Shreveport, La.—The Shreveport Gas, Electric Light & Power Company has completed arrangements for an additional $500,000 bond issue.

Sumas, Wash.—The city council has granted a franchise to H. W. Vanderhoof, of Portland, Ore., for the construction of an electric lighting system.

Sumner, Ia.—Leon Stewart, of Omaha, has been granted a franchise to operate an electric light plant here.

Tacoma, Wash.—The electric lighting service here is to be improved in anticipation of the heavy demand that will be made upon the plant during the winter months.

STREET RAILWAYS.

Carlinville, Ill.—There is to be another electric railway operating between Jerseyville, this city and Alton, to be known as the Carlinville, Alton & St. Louis Railway, with principal offices in Jerseyville.. The incorporators and first board of directors are: Andrew W. Cross, Joseph M. Page, Joseph W. Becker and John McGrath, all of Jerseyville; Aaron C. Anton, of Chicago, Robert Curdie and June M. Rhoads, of Alton.

Chicago, Ill.—McHenry County has good prospects of having an electric road built to McHenry from this city. This road will be built by the recently incorporated Illinois & Wisconsin Railway Company, with a capital of $10,000, and its principal office here.

Erie, Pa.—A new trolley line is projected to connect this city with Edinboro, Cambridge Springs, Union City and Corry, and 1,000 men will soon be busy grading and laying rails.

Fort Wayne, Ind.—The Muncie, Ft. Wayne & Bluffton Interurban Railway Company has been granted a franchise into this city.

Hartford, Conn.—Announcement has been made that within a month work will begin on the construction of an electric railroad between Worcester and this city, to be known as the Hartford & Worcester Street Railroad. The railroad will be built and managed by the same interests which control the Boston & Worcester Street Railway, and will form practically a continuous line from Boston to this city. The cost of the system will be about $3,000,000,

Kankakee, Ill.—The Kankakee electric street railway system and electric park were lately sold to a syndicate consisting of E. D. Risser, of Paxton, R. A. McCracken and others.

Kenosha, Wis.—The Kenosha Electric Railway Company is planning to build a spur track to connect with the line now being built by the Chicago & Milwaukee Railway Company, and it is expected that the people can travel from this city to Chicago by trolley before the first of next year.

Knoxville, Tenn.—The Knoxville Traction Company has introduced into this city an electric signal system.

Lockport, N. Y.—The Niagara Falls & Lockport Electric Railway Company has been incorporated with a capital of $200,000 to build a road connecting by the most direct trolley route Niagara Falls and this city. The proposed trolley line will be about 20 miles long. The directors include a number of well known men of Buffalo, namely: Edward Michael, Clark L. Ingham, W. D Ingham, Elgood C. Lufkin, Isadore Michael and John M. Bradford, also S. P. Franchot, William P. Baker and James S. Simmons, of Niagara Falls.

Maysville, Ky.—Articles of incorporation of the Maysville, Carlisle, Millersburg and Paris Traction Company have been filed in the Mason County Clerk's office here. The capital stock is $30,000, and has all been subscribed. The company is limited to the issuing of bonds to the amount of $1,500,000.

Owensboro, Ky.—Indications are that the long-talked-of electric railroad from here to Calhoon and Hartford is about to be built.

Rockford, Ill.—It has become known through engineering circles that an electric road is coming into this city from the South.

Shawnee, Okla.—The Oklahoma Electric Railway Company, with $250,000 capital, has been incorporated for the purpose of building an electric line from Tecumseh to connect with the Shawnee Traction Company's lines.

St. Clairsville, O.—The franchise for the Wheeling Traction Company's river line has at last been granted.

Warren, O.—The Youngstown & Ohio River Traction Company, which was promoted two years ago by Max P. Good and some other Cleveland people, will build an electric road.

Wooster, O.—The Wooster-Mansfield trolley line will soon be built. The necessary bonds are nearly subscribed, and when a little more stock is sold, work on construction will commence. Philadelphia parties subscribed $700,000 to the road.

POWER PLANTS.

Americus, Ga.—An electric plant, supplying day power for manufacturing enterprises, will in all probability be erected here, and the company controlling it proposes installing a street railway system as well. The latter enterprise alone will represent an investment of $150,000.

Fort Fairfield, Me.—The work of surveying for the large plant to be built at Aroostook Falls to develop the water power of the Aroostook River, has begun under the direction of the Maine & New Brunswick Power Company. The estimated horse power at the falls is 8,000, and the river has a drop of 72 feet in three-quarters of a mile. Electric power will be furnished for a greater part of Aroostook County and the western part of New Brunswick, including this place, Houlton, Presque Isle, Caribou and Limestone in Maine, and Andover and Perth in New Brunswick.

Winston-Salem, N. C.—The Winston-Salem Power Company is arranging to begin work on the new electric power plant to be located near the Salem Creek.

BIDS WANTED.

Charleston, Ark.—J. A. Corbell is in the market for machinery and equipment and estimated cost of construction of electric plant to furnish light to 600 residences, 100 stores and 20 arc lights, including generator, wire etc.; also cost of equipment for power plant to operate a motor car 20 miles.

La Grange, Ga.—Bids will be asked in about 30 days by the Electric Light Commission for the construction of an electric light and power plant. Roy Dallas is city engineer.

Marksville, La.—Sealed bids for the construction of a system of waterworks and an electric light plant for this city, will be received up to 4 P.M. August 24. C. Ashton Smith mayor.

Winnipeg, Man.—Sealed tenders addressed to Alderman J. C. Gibson, chairman of the fire, water and light committee, for a 500 kilowatt electrical generating plant will be received until 3:30 P.M. August 28.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅜@15½c.; Lake 15⅜@15½c.; casting, 14⅞@15⅛c.

July gross earnings of the Philadelphia Rapid Transit Company increased $80,000 over July of last year.

According to a director of the Chicago Telephone Company there will be no necessity of a new stock issue this year.

The Dallas (Tex.) Electric Corporation has authorized an increase of preferred stock from $1,500,000 to $2,000,000.

New York Interborough Rapid Transit stock on Monday advanced to 222¼, but before the day was over dropped back to 219.

The gross earnings of the Brooklyn Rapid Transit Company for July exceed, according to a reliable authority, $1,600,000.

The stockholders of the Philadelphia Rapid Transit Company will hold their annual meeting on September 20. Books close August 30 and reopen September 21.

A statement from headquarters says that the surplus of the General Electric Company is approximately fifteen million dollars, equal to 30 per cent. of outstanding stock.

The stockholders of the Allis-Chalmers Company will hold their annual meeting at 15 Exchange Place, Jersey City, on September 7. Books close August 17 and reopen September 8.

The foreign demand for copper continues very strong, with the exception that there has been a slight temporary let-up in the Chinese buying. Europe is taking a large amount of our copper.

The reorganization plans of the Eastern Ohio Traction Company are progressing rapidly. Before the end of the year it is believed that the receiver will have been discharged and a reorganization completed.

The Pennsylvania Railroad Company announces that it will extend the elevated railroad tracks in Pittsburg along Duquesne Way to East End and to Braddock and beyond and will use electricity as its motive power.

Judge Grosscup has entered an order allowing the receivers of the Chicago Union Traction Company to issue receivers' certificates, maturing February 1, 1906, to take up first mortgage bonds of the Chicago Passenger Railway Company.

A dispatch from Cleveland says that the National Carbon Company will soon have a competitor in the United States Carbon Company, which is to be organized with a capital of about one million dollars. It is said that Rockefeller interests are backing the new concern, although this is denied at Standard Oil headquarters.

A director of the Metropolitan Street Railway Company of New York says: "Earnings of the Metropolitan Street Railway Company are the largest this summer in the history of the company and prospects for the future were never so good as now. The Interborough has been a benefit to the Metropolitan by reducing long distance travel and increasing short haul travel."

Notice of the merger of fifteen electric light and gas companies in Luzerne County, Pa., with a capital of one million dollars, has been filed in the State Department at Harrisburg with the approval of Governor Pennypacker. The officers of the new concern are: C. H. Geist, Philadelphia, president; H. W. Noble, Detroit, vice-president; C. B. Kelsey, Grand Rapids, Mich., secretary and treasurer.

ELECTRICAL STOCK QUOTATIONS.

Name.	Closing price Aug. 7
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	219
Manhattan Elevated Railway	166¼
Metropolitan Street Railway	128¼
Metropolitan Securities	88⅝
Ninth Avenue	197
Third Avenue	127¼
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	70
Brooklyn City Railway	239
New Orleans Railway	30¼
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	82
Philadelphia Traction	100
Union Traction	60
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	17¾
do. do. do. pref	60¼
West End Street, com	97¼
do. do. do pref	118¼
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	9¼
do. do. pref.	37
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	18¼
do. pref.	61
Electric Boat, com	28
do. do. pref.	68
Electric Vehicle, com	18
do. do. pref.	20
Westinghouse, com	168
do. pref.	190
General Electric	179¼
Boston.	
Edison Electric Illuminating	246
General Electric	179½
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	157¼
National Carbon, com	60¾
do. do. pref.	118
Philadelphia.	
Electric Company of America	11⅞
Electric Storage Battery, com	82
do. do. do. pref.	82
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	138¼
Western Telephone Company	17¾
New England Telephone Company	86¼
New York.	
American Telegraph & Cable Company	190¼
Commercial Cable Company	210¼
Mexican Telephone Company	¾
New York & New Jersey Telephone Company	179¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93⅝
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Chicago Subway	85
Otis Elevator Company	58
Standard Underground Cable	..
Twin City Rapid Transit	117⅝

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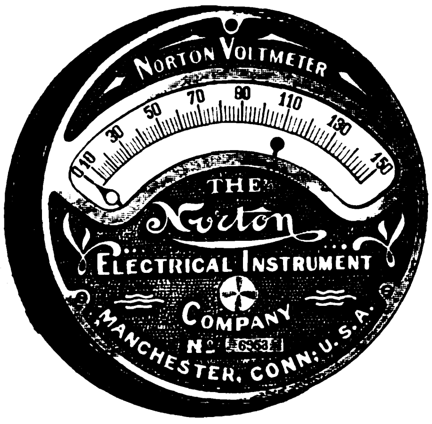
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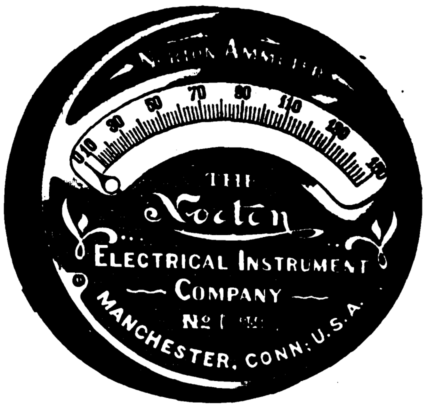
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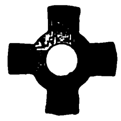

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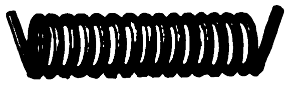

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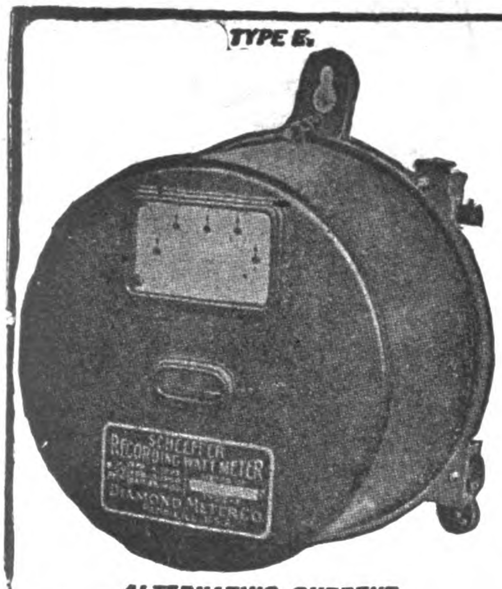

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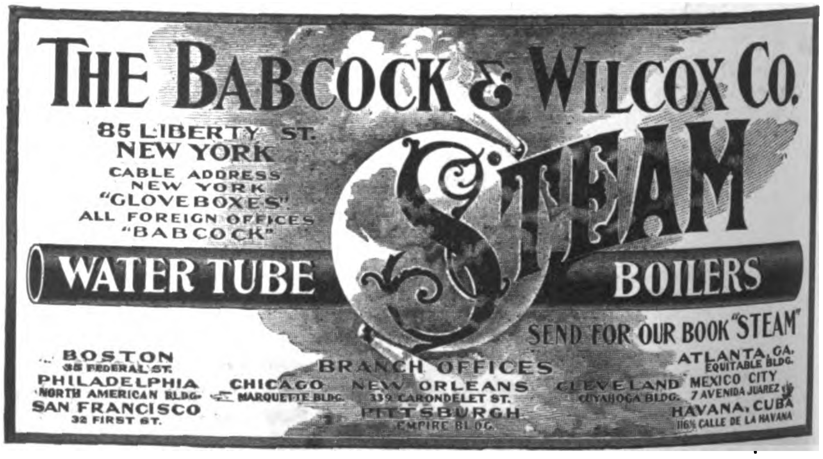

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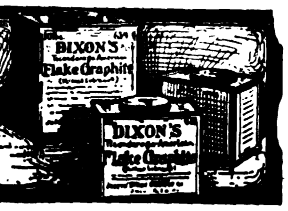

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ELECTRICITY.

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EDITORIAL NOTES.

The New Telephone.

The new telephone, or rather, the new telephone device, is about to make inroads upon the old order of things. The fact that its introduction has been rather slow does not militate against it. Its merit is obvious and for this reason a few of its most imminent applications are worthy of review. To be able to speak into a telephone and know that the message is received and recorded will inevitably lead to a species of satisfaction that will remove much of the annoyance felt, due to the absence of those with whom communication is desired. Their physical presence, in many instances, is not so great an advantage before or during the receipt of a message as after it has been received. A contemplation of some of the messages received, away from the influence of those sending them, may have the effect of altering opinions and decisions most markedly. In business life, where dispatch is believed to be imperative, errors are made more frequently if statistics count for anything, than anywhere else. The attachment of a device by means of which the record of all speech received is preserved, will undoubtedly throw a peculiar light upon the conversations of men, more with respect to their indefinitness than their explicitness.

The art of speaking into a machine in which there is no response calls for more than an ordinary effort on the part of the novice. The Poulsen invention cannot, therefore, meet with instantaneous success, but in certain respects a telephonic recorder would outshine the newspaper, if, by its use, the news of the day could be made to reach the feeble and the blind.

In Buda Pesth a telephone newspaper has been in use for several years with considerable success. It consists only of a receiver, not a transmitter. At certain stated intervals during the day, messages are received all over town by subscribers, and the local, national and international news disseminated widely and effectively. By means of the Poulsen attachment, a long ribbon of steel tape may preserve its record for years. The value of this, its compactness and ready advisability certainly marks the possibility of a new epoch in telephone development.

It is essentially a telephone instrument, not as some are led to believe, merely a phonograph of peculiar construction. It seems to possess all the qualifications that indicate practicability, and for this reason, its usefulness in the broad fields of commercial life and journalism will not be affected by the need of continued repairs, adjustments and annoying attentions. To the very busy classes of financial men, the knowledge that the telephone will hold all information, until their time permits them to review it, will mean not only an enormous extension of business possibilities but a relief from the actual physical strain of immediate response. In legal transactions such a device will assume the dignity of a document. It will rapidly put a stop to incoherence and indefiniteness over the "phone."

* * *

The Benefits of Railroad Competition.

Although our regard for some things is largely based upon their financial accessibility, there are notable instances where our ultimate appreciation is due to the effects of a persistent competition. In this respect it is interesting to view, from a broad and general standpoint, the benefits of railroad competition, how it has affected a marvelous change in our modes of travel, how it has annihilated distance, and finally how it has developed a new traction system, the advantages of which are going to be so widespread as to threaten to ingulf the value and prestige of the well-known steam road. It is so generally accepted as true that railroad competition is merely the cutting of rates; that the business methods employed are directed along purely commercial lines; that, in fact, a supervising business management of a high order, is all that is required to transform a franchise, tracks and rolling stock into an active center of railroad prosperity. This, we say, is the commonly accepted belief, and, in consequence, the true spirit of railroad competition has been lost sight of—the appreciation of improvements necessary to a wholesome success; the purchase of new machinery to replace the old; the equipment of the cars and their accessories; and the legitimate inquiry into the possibilities of other traction systems, like the electrical, for instance.

The benefits of railroad competition are only correctly regarded, therefore, as the benefits of railroad progress. In this respect, where can progress be better found than in the plans and specifications of the New York Central and the Pennsylvania Railroads? In a certain sense the necessity for modern progress arises through the desire to continue in existence. In other words, progress and preservation are almost synonymous in railroad work. As far as this idea has crystallized, it is in its best form in electric railroad work. It is approaching a stage of development and trustworthiness that promises great things. It is the index of American enterprise and investment. Who can say whether its influence will end with anything less than a trunk line across the continent?

* * *

Our Wire Manufacturers. One of the interesting features of the electrical supply trade, is its steadily increasing volume. The variety of supplies and devices now obtainable present a unique case in the development of this particular field of industrial work. The element of inventiveness displayed betrays itself in a constant and ever increasing effort to improve upon the old order of things. Not only are devices in particular developed to a high point of perfection, but the general character of those representing parts of a system also receive proportionate attention. Specific cases could be referred to illustrating this fact. One, however, is well worthy of attention because of its full qualification as a sample of the results of systematic improvement. The manufacture of wire, for instance, exhibits a series of ramifications that cover an immense territory in a metaphorical sense. Plants which turn out a No. 40 silk-covered wire are differently equipped from those manufacturing a transatlantic cable. Yet between these two extremes lie an immense variety of other kinds, required in electric lighting, bell and annunciator work, electric telephone installations, electric power, street railway and conduit work, and railway signal and fire alarm or messenger equipments. The manufacturers of general lines of machinery, such as motors and generators, consume enormous quantities of wire and the demands they make are so different in the way of insulation and cost, from those of the installer of electric light cable, that it is readily realized how large and diversified a knowledge is necessary to meet these different contingencies. The builder of coils and telegraph relays belongs again to quite a different category. Where special forms of insulation are required to overcome difficulties in daily practice, ordinary skill will not suffice and a scientific study of these new limitations becomes an immediate necessity. The maker of rubber-covered insulated wire has the contractor and jobber on his back They in their turn, have the underwriters and any other fire insurance inspectors demanded by law, overseeing and testing the quality of their goods, so that it is seen that the mere process of covering copper wire with insulation is not sufficient to meet municipal conditions at least. The wire manufacturer is thus the exponent of high quality. In fact, it is practically impossible to dispose of poorly made material, in the present stage of the profession of electrical engineering, under any circumstances, but to retain high qualities throughout this varied assortment of grades and kinds of wire is not an easy task. It is only through costly experimenting that so successful an issue has resulted.

◆

A new pattern army field telephone is to be experimented with this month in England. It is somewhat similar to that in use in the Japanese Army. The apparatus, strapped to the shoulder of an infantryman, contains a reel of 200 yards of one telephone wire, and a receiver and transmitter. It is claimed that telephonic communication can be kept up for several miles by a handfull of men, and instructions accurately conveyed to commanders in the firing line from the directing staff, the use of gallopers being thus almost dispensed with.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Experiments in electric smelting, which are to be conducted at Sault Ste Marie, Canada, will be completed in about two months. M. Herault of La Praz, Fance, inventor of the Herault system of smelting by electricity, is now on his way to America and will go to Canada to give the Government the benefit of his advice.

◆

Municipal ownership at Spirit Lake, Ia., has proven a failure and the water works system and electric lighting plant are to be turned over to a private party.

◆

According to a report received Friday at the Navy Department, Washington, D. C., ships of the North Atlantic fleet have communicated with one another by wireless telegraph at a distance of about 262 miles.

◆

One of the most violent electric storms experienced in years burst upon New York City and the surrounding country last Sunday afternoon and wrought great damage. One person was struck by lightning and killed and a score of others seriously hurt. Buildings were set afire, telephone and telegraph wires were wrecked and trolley car service in some sections was at a standstill.

◆

The fire alarm system in Boulder, Col., had not been working satisfactorily and the batteries at the fire station were thoroughly overhauled, but to no avail. A systematic search was then made when it was discovered that red ants had carried sand up into one of the boxes, getting access to the inside by means of the keyhole. They had taken in enough sand to ground the entire system.

◆

According to an English contemporary a new apparatus has recently been brought out by means of which electric heat may be applied to the inner ear. One end of an "otoscope" is inserted in the external ear, the other end remaining open for viewing the interior surface, and the heat from an electric coil in this is blown through into the ear by a hand-bulb, or otherwise.

SETTING TYPE BY TELEGRAPH.

BY A. FREDERICK COLLINS.

During the past few years several successful printing telegraph systems have been placed on the market, and among the most noteworthy of these may be mentioned the Baudot, Rowland, Buckingham and the Murray. Machines of the latter type are now being subjected to tests by the British Postoffice. A prolonged trial of their merits is going on in the German Telegraph Service and a number of the instruments have been ordered by the Russian Government.

As originally designed the Murray Telegraph Printing System was not intended for sending messages between distant points, but for operating linotype machines automatically; that is to say, a perforated tape which had been produced by a typewriter keyboard was utilized to actuate the mechanism of the typesetting machine. In developing his ideas with this particular purpose in view, Mr. Murray ascertained that his invention was equally applicable for telegraphic transmisssion, and, further, that operating a linotype at a distance was as easy of accomplishment.

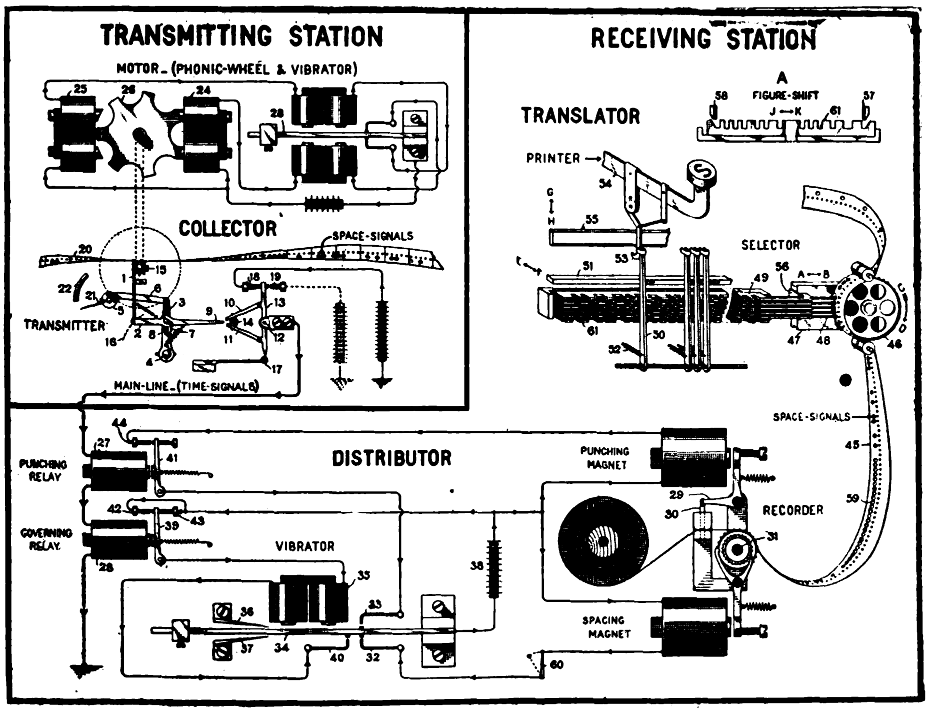


Fig. 1.—General Diagram of Murray Automatic Printing Telegraph System.

In the Murray automatic system the transmitter comprises a collector, a motor and a vibrator, while the receiver includes a distributor, recorder and translator. The arrangements employed at opposite ends are clearly set forth in the diagram, Fig 1. The first step in sendinga message is to prepare a tape by means of a perforator, a device having a keyboard like a typewriter, but instead of printing Roman letters it translates these into a telegraphic code and punches them in a tape of paper. Figs. 2 and 3 show photographically the keyboard perforator. It is operated on 110 or 220 volts direct current, and to avoid sparking at the punching contacts a condenser is shunted around them. The case serves to support a feed wheel for the tape of the ordinary Wheatstone type.

The perforator is formed of a punch block and five punches, and these are operated by the armature of an electromagnet which punches on its first stroke and feeds the tape one letter space at a time, on its return stroke. The perforator is essentially electromagnetic in action yet there are only two electrical contacts—one for punching and the other used as a letter counter to indicate the length of the lines for page printing. The keyboard has 33 characters and the touch of the keys is very light and the play short, so that these factors interfere as little as possible with the highest speed the operator is capable of attaining. The translating mechanism is simple and the complete instrument is quite as portable as an ordinary typewriter.

The correction of errors on the tape, for which the Murray system is noted, is accomplished easily and quickly. In all other telegraph printing schemes it is necessary in order to change a single letter to rub out an entire line. In the Murray apparatus when a correction is to be made the operator rectifies his error by striking the key of the back-spacing lever, the letter shift key and then the letter required. This eliminates the great objection of operators to machine printing telegraphs where the danger of making a mistake distracts his attention and causes him to work much more slowly.

After a number of messages have been punched on the tape it is put into the automatic transmitter. In the Murray single-line transmitter the electric impulse is not broken up into a succession of dots, as in the Morse system, by the separate holes, but a continuous telegraphic signal is sent over the line which is equal in length to all the perforations representing a letter. Where those parts of the tape intervene that are not punched the current is reversed and is so maintained until fresh perforations appear.

In the construction of the collector a rod 1 is pivoted near its middle on a vertical lever 3 which turns on the pin 4; the lever 3 is given an oscillatory movement by a small eccentric wheel 5 acting through the rod 6 which is similar to that employed in a Wheatstone transmitter. The thrust lever 2 has a tooth 7 on its under side, which rests against a pin 8 in the vertical lever 3; the to-and-fro motions of the lever 3 causes the horizontal lever to oscillate also. The end of the thrust lever 9 approaches closely the ends of the converging thrust-bars 10 and 11, which are oppositely disposed and pivoted on either side of the pin 12 of the contact lever 13. The ends of the thrust-bars are made to impinge on a friction roller 14 by means of small wire springs, while the jockey roller 17 causes the lever 13 to make a good contact with the points 18 and 19.

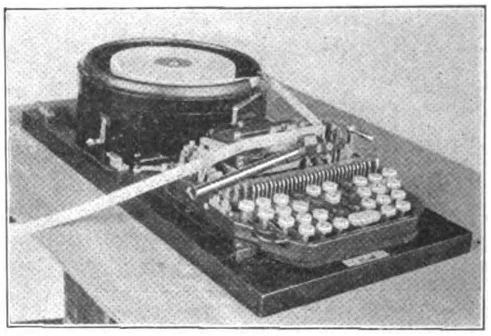


Fig. 2.—Keyboard Perforator with Cover Off.

When in action and the tape with its perforated message is fed through the transmitter in the usual way the small steel rod 1 reciprocates regularly against the paper tape 20, the dotted lines describing the arc 16 showing its course. For each unit of the tape the rod reciprocates once, the eccentric wheel 5 making two revolutions every time the star-wheel 15 revolves once, the shafts carrying the wheels having gears in the ratio of 10 to

1, as indicated by the dotted circle. Whenever the tip of the rod enters a hole punched in the tape the rod is free to complete its motion and this allows the thrust lever 2 to move as if it and the vertical lever 3 were of one piece, so that its movement compels its free end 9 to strike the projecting end of the lower thrust-bar 11, when contact is made by the lever 13 and pin 18. This action takes place every time the rod enters a hole in the tape though there is no movement of the contact lever, as it is already against the marking contact, being held there by the jockey roller 17 and the marking current continues to be sent out to the line; the instant that a portion of the tape that is not punched comes between the small rod and the plate above then the former cannot complete its reciprocation and the tape in this manner breaking the circuit of the marking current and the spacing current is sent to the line instead.

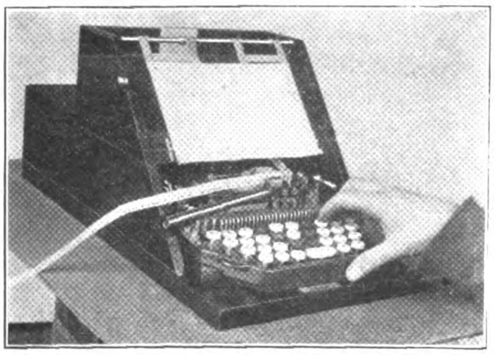


Fig. 3.—Keyboard Perforator.

To insure that the positive and negative current units or half waves shall be of equal length a small steel pointer 21 is attached to the eccentric wheel 5, which, as we have seen, makes one complete revolution for each half-wave positive or negative, the pointer indicating on a scale 22 when the bias as the difference between the negative and positive half waves is called, has been eliminated, for when there is no bias the needle will come to zero the instant the contacts of the positive and negative currents are broken; if, on the contrary, bias does exist the contacts can be adjusted until it disappears.

Fig. 4 is a photographic view of the single line transmitter. At the back of the rectangle frame is a La Cour phonic wheel motor that drives the transmitter, which is shown in detail in Fig. 1. A reference to this drawing shows that it consists of a vibrating reed 23, which sends electrical impulses alternately to the two-motor magnets 24 and 25, and these acting on the armature 26 keep it in constant rotation.

The impulses from the sending station are received by the distributor at the receiving end. Two relays, one for punching and the other for governing, a vibrating reed and a recorder comprises the apparatus of the distributor. Through the medium of these two local relays, 27 and 28, the electro-mechanism of the distributor is governed. The recording device is formed of a punching magnet and a spacing magnet; the punching lever 29 and the punch 30 is operated by the punching magnet. This punch of the recorder corresponds with the small rod of the collector, that is, the punch duplicates the motion of the rod and hence reproduces exactly the perforations in the tape.

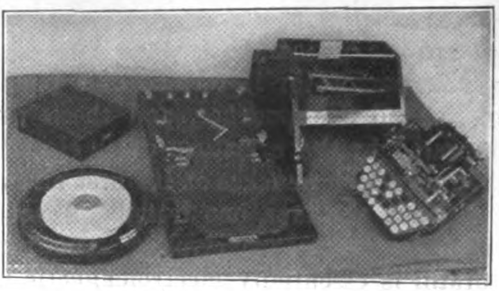


Fig. 4.—Keyboard Perforator Worked by One Magnet on any Electric Light Circuit.

The function of the spring magnet is to feed the tape, unit by unit, through the recorder, which it does by an escapement, the star wheel of which is driven by a motor on the spindle 31. That the alternating current action of these two magnets may be had the windings of the magnets are placed in separate circuits, which are made and broken by the contacts 32 and 33 through the vibrating reed 34, operated by the magnet 35, and as the reed vibrates short impulses are sent first to the one and then the other magnet.

Isochronism only is required between the sending and receiving stations, synchronism being essential between the different instruments of the receiver. Isochronism means the identical speed of two bodies at a distance from one another and synchronism means identical speed and phase of two bodies at a distance from each other. It is a physical impossibility, Mr. Murray has pointed out, to secure synchronism between a transmitter and a receiver in telegraph systems, as the current impulses always lag at the receiving end; for this reason there is really no such thing as synchronous systems of telegraphy and the nearest they ever get to it is an approximation of synchronism, and the more exact the conditions of synchronism are the more inefficient the system employing it. The Murray system utilizes isochronism alone between the distant instruments, and this is easily and perfectly secured.

To secure isochronism the reed 34 is made to vibrate by the magnet 35, the abruptiveness of the movements of the former being counteracted by the buffer springs 36 and 37. The circuit, which includes the reed magnet 35 and the battery 38, has two make and-break contacts, the first through the action of the tongue 39 and the second the reed contact 40. The relays for governing and punching are exactly alike and are operated from the same source of electromotive force, so that they are synchronized perfectly, the tongues 39 and 41 being exactly the same period.

The front and back stops, 42 and 43, of the governing relay are electrically united so that at the beginning and end of a main line signal, when the tongue of the governing relay changes from one contact to the other, the circuit in which the reed is placed is broken while the tongue is in transit. In this way, synchronism between the relay tongue 41 and the vibrating reed 34 is obtained, for they must not only vibrate at the same rate but in the same phase as well. Thus when the tongue 41 makes contact with the point 44 the reed at the same instant makes contact with the point 33, though the latter may be vibrating at the rate of 75 times per second and 150 words per minute is going through.

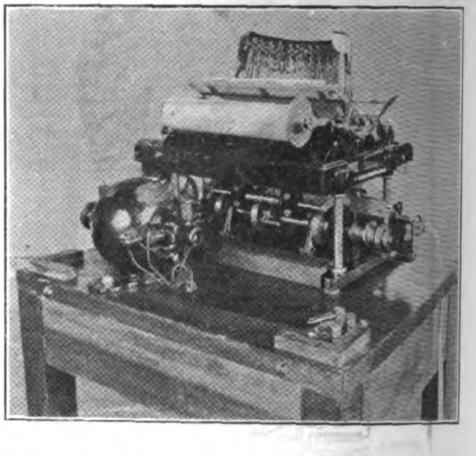


Fig. 5.—The Printer Complete, Including Typewriter.

The transmitted message having been punched on the receiving tape 45 by the devices described, the tape may be used for any one of a number of purposes, namely, for transmission over other circuits, or it may be run through a printer and the signals translated into printed letters on a page, or it may be used in conjunction with a linotype machine and the message set up and cast in type ready for press.

If the message is to be typewritten the tape is fed letter by letter by a star wheel 46 which is attached to a shuttle 47, the latter reciprocating between the points A and B, indicated by the double arrow. This movement is procured by the use of a cam, each reciprocation rotating the star wheel one letter space as shown by the arrow C–D. The shuttle carries a die plate coinciding with the circumference of the star wheel and having five holes in it, corresponding with the message holes in the tape. Five rods, 48, are fixed in the ends of the slotted combs or plates, 49, the rods being free to enter the five holes in the die plate if they are not obstructed by the paper tape which passes between the rods and the die plate.

When the shuttle with its die plate makes its inward stroke it presses the tape with its perforations, representing letters, firmly to the ends of the five rods. Where holes in the tape occur the rods pass through into the die plate and the positions of the corresponding combs are not altered, but where the tape is not perforated the corresponding combs are thrust back a sixteenth of an inch. This arrangement permits one particular group of slots in the combs and only one of the 56 combinations to be brought into alignment, so that a latch or cross-bar 50 can drop into it.

In the drawing only four latches are shown, but there are 56 of the small levers, one for each of the 56 permutations or groups of slots. A universal bar, 51, that just clears the teeth of the combs supports the latches or cross bars. At the proper instant the universal bar drops in the direction of the double arrow F E, leaving all the cross-bars resting on the combs, but only one out of the 56 is selected by the particular aligned group of holes in the tape. The combs form a system of 56 inverse permutation locks of which the cross-bars are the bolts or latches and the universal bar the master key.

One of the novel features of the Murray system is that it will automatically set type by telegraph, as already indicated. Thus, when a message arrives at the receiving station the holes punched in the tape will operate special keys on a typewriter, pulling the typewriter carriage back when necessary and working it as if by human hands. In the same manner a linotype machine is worked; a press message sent off in the usual way may, by means of the Murray apparatus, be set up in type at the other end and all over a single wire.

Nor is this the limit of its advantages, for it is possible to utilize the printing telegraph in connection with ocean cables, and what is more to the point, the prospect for its early achievement seems bright and hopeful. Experiments along this line are now in progress, the plan having been rendered feasible by combining the Murray apparatus with S. S. Brown's cable relay and perforator and using what is known as the Cooke alphabet.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

THE INCANDESCENT LAMP.

Introduction.—Much of the development of electric plants in the United States is directly attributable to the incandescent lamp. In the beginning nearly all the electric lighting was done by its means, and the extensive use of electricity was divided up between the arc and incandescent lamp, and very few motors. Arc lights were employed solely for outdoor illumination, and while representing a good quota of such electric lighting as was done in the early days, it belonged to quite a distinct and undeveloped field. The incandescent lamp, however, has passed through evolutionary processes of manufacture as well, and its origination, first appearance and final stage of manufacture will be recorded from scientific, commercial and economic standpoints.

First Experiments.—The heating of a wire in a glass bulb, from which some air had been removed, led to the further experiment of exhausting the bulb still more and noting the increased brilliancy and durability of the wire under these conditions. The glass bulb supplied with electrodes was used in physical laboratories for the purpose of demonstrating the peculiarities of a static charge in a vacuum. The need of an air pump of a better quality than those composed of a cylinder and piston led to the invention of the mercury vacuum pump. In this device a much higher vacuum than that ordinarily obtained was secured by letting mercury drop down a tube to which the bulb to be exhausted was attached. Globules of air were removed in this manner until, by continuing the process, the air in the bulb was reduced to what is now called so many millimeters or parts of a millimeter exhaustion, or a hundredth, thousandth or millionth of an atmosphere, as the case may be.

The improved method of getting a good vacuum stimulated inquiry in the inventive field with regard to the incandescent lamp. A high resistance wire was employed, the heating of which meant a certain amount of light. The light was brighter the more current was sent through the wire, until a point of volatilization was reached. This experiment, of raising platinum wire to a high point of incandescence, which gave rise to a brilliant light, though of a temporary and expensive nature, led to efforts to make the device more permanent as a light giver. Thomas Alva Edison's name in the United States and Swan's in England are connected with this stage of its history, and it is curious to note how their experiments, in many respects, parallel each other, although the Atlantic Ocean lay between the two laboratories and great secrecy attended the work of each.

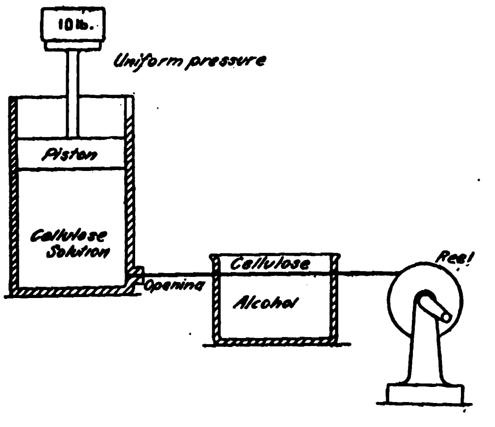
The platinum wire proposition was rejected after a while, also the hope of using metallic alloys of any description for a filament. The vacuum served to free the wire from the presence of oxygen and the effects of the radiation of the heat into the air which would otherwise be surrounding it. But though an indispensable precaution, the wire filament even under these advantageous conditions could not long resist the high temperature due to the current and its resistance. Edison followed the idea that a filament must be made with grain if composed of carbon. Swan believed the filament must be homeogenous if its properties were to give durability. Thus operating on different lines of investigation, one discovered in bamboo a good material, when carbonized, from which filaments from lamps could be made. The other treated threads with acid and with subsequent carbonization accomplished equally good results.

Why Carbon is Employed.—The use of carbon for a lamp filament was in itself a discovery of no mean importance. It was led up to as the result of conclusions arising from considerations of temperature and vacuum. The metals melt and volatilize readily beyond a certain degree of heat. Carbon, on the other hand, is very difficult to soften by heat, and its volatilization takes place in a very slow and limited manner. Carbon is thus specially adapted to fill a unique field in this respect, for the additional reason that the high temperature will not lead to its destruction unless carried beyond a certain high danger point, nor will it become consumed unless air is present. Holding the current in check and heating the carbon in a good vacuum thus expressed the correct working conditions.

Another reason why carbon is peculiarly suitable to this purpose is its high resistance. Although the question of its resistance is by far the most important, in respect to its current consumption, etc., the fact that its resistance rapidly *lowers* with each fresh access of current is one of the strongest arguments against it. But in other respects it is incomparably better than metals of any description, although of late certain rare metal oxides have been introduced successfully for incandescent lamp manufacture. Maxim used paper to make filaments from and Edward Weston employed a cellulose compound.

Whatever the direction of past or present experiments may be, the fact remains that a certain length of carbon filament is required to consume a certain amount of power. Under these conditions a certain amount of heat and light will be generated. One horse power of electrical energy produces enough heat and light, by passing through lamp filaments, to give from 160 to nearly 300 candle power. In other words, a long carbon filament could be inserted in a long glass tube, exhausted like a lamp bulb, and its length and light could be regarded as a fair standard of the results to be obtained from a detached series of lamps under ordinary conditions of practice. The filament is thus merely a heat machine transforming electrical into thermic and thermic into light energy.

Filament Manufacture from a Solution.—The original methods of making filaments have naturally undergone radical improvement. The bamboo strip is no longer employed, neither is the thread treated with acids, but a semi-liquid or viscous nitro-cellulose solution has taken the place of nearly all of the former filament bases. This is a product obtained by definite chemical processes, and is utilized for commercial purposes by forcing it through an aperture in a die or plate from which it issues as a fine thread-like length of translucent material. A vessel of alcohol receives this extending filament, affecting it sufficiently to harden it so that it may be reeled and laid away as stock for future use. The most evident of the chemical salts present in the filament, which must be absolutely removed by persistent washing is zinc chloride. A review of the process shows that one of the serious difficulties met with are air cells or bubbles of varying sizes. These are partially obviated by agitating or stirring the solution, but in spite of all precautions their presence is a constant menace to ultimate success.



Making lamp filaments from a solution.

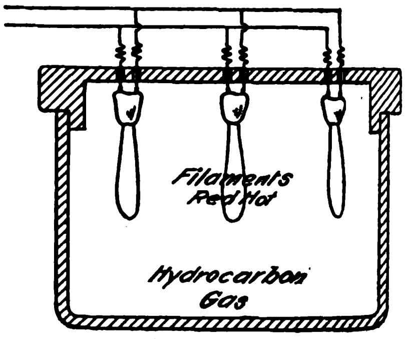
One of the remedies employed is heat in a vacuum retort, but this must be most judiciously regulated or the solution will suffer permanent injury. The filament thread, after being thus prepared, is of the general appearance and strength though of less diameter than a silk violin E string, or the material used for holding fish hooks to lines. The next step in the process is that of cutting up the material into certain lengths preparatory to the carbonizing process. The technical term squirting is given this method of manufacture, which has become in many respects the generally adopted plan. Various substances were originally tried for the purpose of making a pure and comparatively inexpensive cellulose useful for this purpose; they resulted in the ultimate choice of absorbent cotton, a specially picked and prepared as well as readily available foundation. For mere purposes of comparison it may be stated that the most expensive product in the world is a pound of carbon filaments complete. Hair springs for watches cost less in price per pound, though it is still the popular idea that in this respect they stand first.

Carbonizing the Filament—The care exercised in carrying out the process of carbonization belongs to one of the most delicate processes in connection with incandescent lamp manufacture. Powdered charcoal is used as a bed and covering for the horseshoe lengths, and direct contact with the air is carefully prevented during a long period.

The oven in which the future filaments are to be reduced, is gradually raised to such a temperature that they all become red hot. It is evident that the oxygen of the air would rapidly convert the entire mass into ash, if permitted to act directly upon it. The charcoal acts very effectively in holding any such tendencies in check. When removed the filaments are hard and elastic and appear like fine steel wires. It is supposed that the carbon of which they are composed is of very fine grain, perfectly homogeneous, and of an average resistance throughout. Tests have shown serious differences between filaments in this respect however, and individual filaments are not sufficiently uniform in structure to be ready for immediate use. The practice therefore of flashing represents one of the important preliminaries to the final comcompletion of the filament.

The Process of Flashing.—A microscopic examination of newly carbonized filaments showed great differences in diameter at various parts of the filament and the presence of open pores. The idea was suggested, therefore, of heating the filament to redness, while exposed to the influence of a gas containing carbon. The advantage of this lies in the fact that the carbon of the gas will be deposited wherever the filament is unduly heated, and otherwise it will form a uniform coating, thus removing the drawbacks noted.

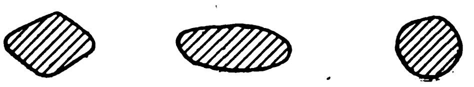
Glass receivers, holding a hydrocarbon gas, such as the vapor of naphtha for instance, are so mounted, that the filaments to be exposed to the flashing process, can be conveniently inserted and treated with the current. All uneven spots in the filaments thus undergo the effects of this method of establishing uniformity. The greater heat at the lesser diameters, means a heavier deposit of carbon there than at other points in the filament. The pores fill equally, and the filament when withdrawn, assumes a metallic luster and springiness which are regarded as its chief characteristics.



Flashing process.

Governing the Resistance of Filaments.—Although the flashing process builds up the filament, in the sense that it makes it uniform, the process in itself has the effect of reducing the resistance in total. In other words, discrimination must be exercised in exposing filaments to the current and gas; otherwise the resistances will be so varied that the impossibility of obtaining lamps of equal wattage and candle power will prevent their commercial exploitation. Thicker filaments than others can be kept longer in the gas, and during the flashing, tests of amperes and volts will indicate the exact value of the resistance. This cannot be done successfully when the filament is cold, because of its variation in resistance between the two degrees of temperature. The resistance of a 250 ohm filament will drop during the flashing process to 225 or even 212 ohms, and it may take place with comparative rapidity, unless the current supply is watched carefully. As the filaments before the flashing express great differences in resistance, it is evident that the commercial requirements make this particular phase of development the most important. Out of a thousand filaments, an equal number of adjustments may have to be made to approximate the standard of candle power. The more uniform the ultimate products of the lamp factory, other things being equal, the greater the advantages where efficiency tests for superiority are to be made.

Selecting the Cellulose Filaments.—When the original filaments are still on a reel they are slightly distorted from their first dimensions, particularly as regards their diameters, by the method of reeling or winding employed. The silk worm exudes a filament and then winds it about itself, thus constructing the cocoon. In this respect the making and winding up of the filament lengths is a similar process. But during that process the semi-hardened lengths change their cross-sections sufficiently to make marked differences when the sorting takes place. After the carbonizing process a sufficiently approximated selection is made to yield filaments so nearly alike in resistance, that the flashing process practically adds the finishing touch. The filaments, however, before the flashing, are measured cross-sectionally two ways, to see whether the width and thickness has provided cross sections that are equal, even though one filament may be a little flatter than another.



Possible appearance of the cross-section of the cellulose filament after winding. Cross sectional dimensions unequal.

Presence of Foreign Matter and Gases.—Volcanic actions seem to fairly represent the general character of the minute, but nevertheless similar class of phenomena, occurring in a filament undergoing flashing. Not only may these eruptions occur in this instance, but when the lamp is finished and in use, a peculiar yellowish black coating will collect within the bulb. All of this is the consequence of the presence of gas in the filament, held by pores developed during the carbonizing process. The original cellulose string is uniform in character, and devoid of perforations, cracks or pores. But the continued heating yields defects, which are partly removed in the carbon gas, although experience indicates their presence in the finished article. Foreign matter, infinitesmal in quantity according to some analysis and investigations, gives rise to equal minute explosions, the effect of which is to coat the interior of the lamp bulb with the film already noted. Oxygen gas is to some extent retained after the carbonization, but it is supposed to be entirely removed and absorbed during the flashing.

Joining Carbon and Wires.—The leading-in wires are of platinum, which pass through the glass into the bulb. Platinum was chosen because the coefficient of expansion as it is called of glass and platinum are about identical. If a metal was used for this purpose which expanded more rapidly than glass, it is quite evident that the glass would crack, air would filter in, and the lamp would be ruined. An equal expansion of glass and leading-in wires thus eliminates this danger, as presentd by the employment of platinum wire. Between these wires and the carbon filament ends junction must be effected by a cement or conducting material, which will withstand the requirements of practice. It was discovered that one of the simplest ways of accomplishing this is to flash the joint. The platinum and carbon terminals are held in juxtaposition and either a carbon gas or liquid is employed to supply the deposit. Its hardness, strength and durability, make this graphite joint one of the masterpieces of the art of lamp construction. Other ways of making a junction between these two elements, are carried out as in the original manner, consisting of the electroplating of one to the other, or clamping one around the other, or by means of a cement. Of these methods, the use of a carbonaceous paste, or the effecting of a junction by flashing, are most general in use.

* * *

EMERGENCY VALVES.

BY W. H. WAKEMAN.

ARTICLE III (Concluded).

Fig. 8 illustrates another emergency valve that engineers should understand, as, like those already explained, it possesses valuable features. It is shown in its normal position when in service with steam passing from 2 into 3, holding the valve 4 open; 5 is the lower part of a cylinder in which there is always at least some pressure to prevent violent closing of the valve. The hand wheel 6 is for lowering the stem 7, thus closing the valve directly by hand when required.

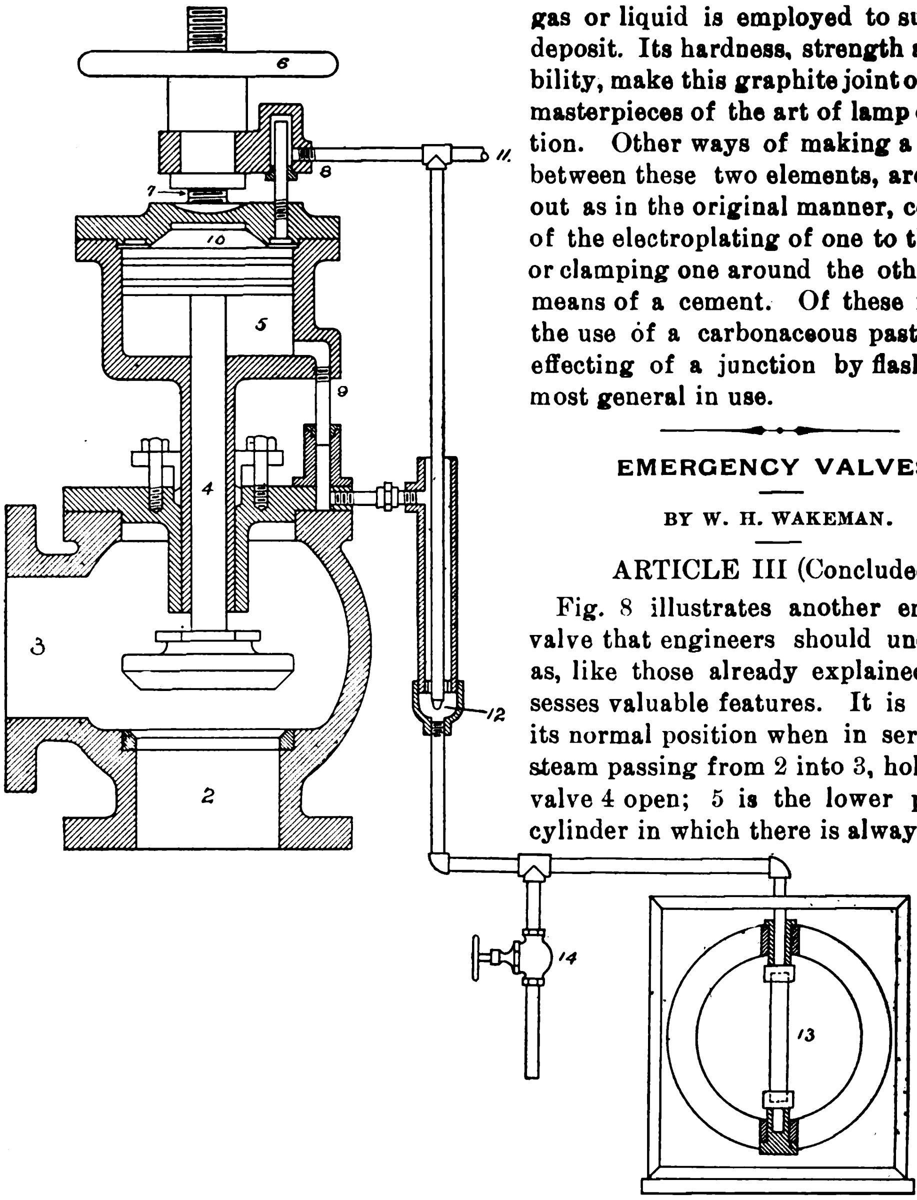


Fig. 8.

Steam is admitted at 8 and also at 9 to the lower part of cylinder 5 (as already mentioned), also to the upper part 10 from the boiler through the pipe 11. The outlet 12 is much smaller than the cross-section of pipe 11.

The steam pipe terminates in a suitable box located in a safe place, where it can be reached in case of accident to the main steam pipe. On the end of it is an ordinary water gauge glass, but the lower fitting is made solid to prevent steam from passing out at this point.

While in ordinary service pressure on both sides of the piston at 5 and 10 is equal, therefore it does not affect the valve 4, but when it is desired to close this valve at the shortest possible notice, the glass 13 is broken by striking it with anything at hand. Steam now rushes out here, but inasmuch as there is an unrestricted passage from 5 pressure below the piston is lowered.

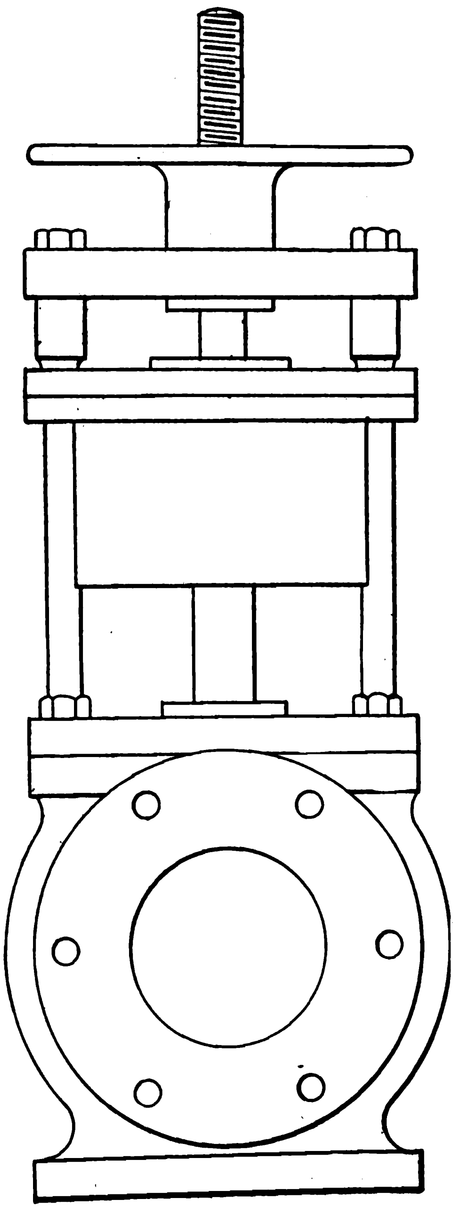


FIG. 9.

The small outlet at 12 prevents pressure from being lowered much in 10, consequently the piston below it is forced downward, closing the valve 4 quickly.

The object of this arrangement of piping is to maintain pressure in the cylinder at all times, so that it will always be ready for instant use. It will be noted that there are no valves to open or close, making a very simple device.

The valve 14 is for testing purposes. If it is opened pressure in the connecting pipes is lowered, causing the main valve 4 to close, if the apparatus is in good working order, and of course this is much more convenient than breaking the glass 13. This valve will not act automatically except to prevent steam from passing back into the boiler.

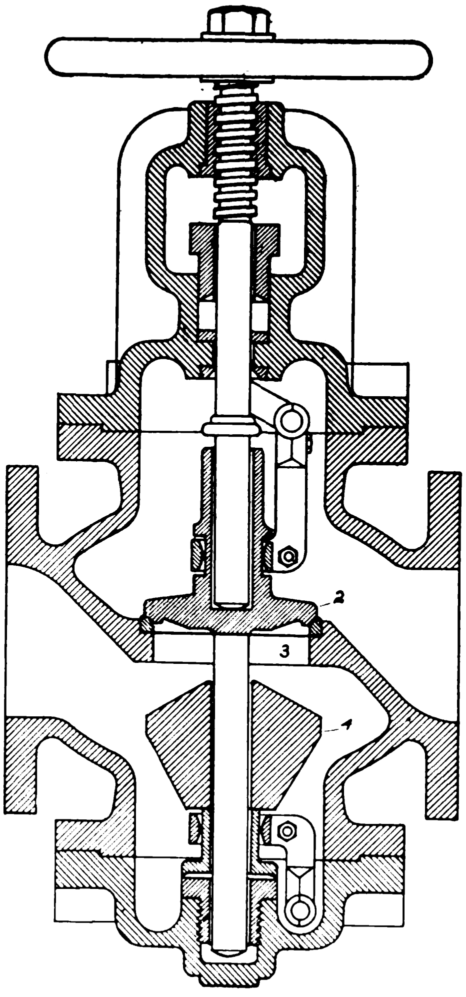


FIG. 10.

Fig. 9 is an exterior view of the same valve, taken at right angles to Fig. 8, showing the supports to the closing apparatus and giving a more complete illustration of the whole. Any of the foregoing angle valves can be secured in globe form if desired.

Fig 10 illustrates an emergency valve that works automatically in either direction and is entirely self-contained, requiring no outside appliances to operate it. The valve stem is screwed down as shown, thus closing the valve mechanically or by hand. When this stem is raised by means of the hand wheel the valve 2 is free to slide up and down. When steam is passing from left to right the valve 2 is open, but if anything causes the current of steam to be reversed, the valve instantly closes on its seat 3 and prevents steam from passing.

This seat is double faced as it is designed for use on both sides, for the large valve 4 is intended to operate against it at times. Suppose, for illustration, that an accident causes a very great rush of steam through this valve from left to right. This will cause the valve 4 to rise on its stem and shut off the supply at once.

Both of these valves are connected to links as shown, which terminate in levers outside of the valve case, thus providing means for testing them at any time, enabling the engineer to know that they are in working order.

This description of emergency valves shows the machinery that must be cared for in one department of the modern steam plant, calling for constant attention from the chief engineer, not necessarily because the apparatus is frequently out of order in common practice, but the ever-present tendency to corrode and fail to work when wanted must be met and overcome or else expensive machinery and appliances will not be worth their original cost in a few months. This does not refer to their selling price as that depends on surrounding conditions, but it does mean their present value when they are badly wanted in an emergency.

The days when muscular strength and bull-head tenacity made the most desirable chief engineer are no longer in evidence in our best plants, as cool calculation and intelligent use of reasoning faculties in connection with a steadfast desire to do all work thoroughly and well are now considered more valuable qualifications and are paid for accordingly.

WRINKLES.*

EDITED BY H. C. ABELL.

Removing Accumulations of Sand, Debris and Anchor Ice from Flumes and Racks.

We use city water-pressure of 70 pounds per square inch, but I think anything over 30 pounds would be effective. The method of application will vary in each individual case.

In our flume we have found that anchor ice will not go out of the sluiceways, but will gather in masses in front of our racks and on the surface of the water to a depth of a foot or more, and if allowed to remain would soon cause serious trouble. By the use of a fire hose, held at an angle with the surface of the water, we can drive the ice out of the sluiceways in a few minutes, while it would take an hour to do the same work by other means. It will be found equally effective in washing out wheel-pits, forebays and flumes when the water has been shut out for repairs, etc. We also make use of this means to deepen the channel of the river leading to our intake when the water is low in summer.

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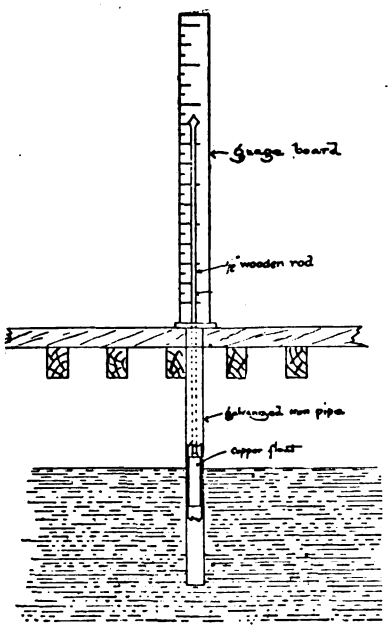
*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

J. C. FAGAN.

Head and Tail Race Water-Level Indicator.

The sketch shows a style of float we have in use to indicate the height of the water in our penstock; another float of identical construction shows the height of the tail water, and, of course, the difference between the two floats is the available head on our turbines.



WATER LEVEL INDICATOB.

The arrangement is very simple and inexpensive, and if the float is made large enough as to contain sufficient air, it is quite sensitive.

S. R. INCH, Missoula, Mont.

An Indicating Head-Water Gauge for Open Flumes.

It is at all times desirable to know the exact head under which a water-wheel is operating. A handy gauge for this purpose can be made as follows:

A float, consisting of light wood or other material is placed in the open flume, and a light rod or stick is fastened to it by nailing or screwing. The stick or rod must be of sufficient length to permit of a satisfactory guide being placed above high-water level to prevent the float from drifting down-stream. The guide may be made of a block of wood nailed to the flume and bored for the vertical rod, or a large screw-eye may be attached to the flume. At the end of the vertical stick or rod attach a wire, and run it over small pulleys to any convenient location for the scale. This should be a stranded wire, and ordinary picture cord will usually be found suitable. At the place selected for the scale the wire should be run over a small pulley, and should drop vertically, the end of the wire being attached to a weight heavy enough to keep the wire taut at all times, and counterbalance the weight of the rod and float to some extent. Attach to the wire a few feet above the weight, by means of a small clamp, or by double-pointed tacks, a scale divided into feet and inches. This scale should be of such a length that the extreme variation of head will come within its limit.

For the tail water an exactly similar float rod, guides, wire, pulleys, etc., should be used, and the wire dropped vertically, with a weight on the end and as near the scale as possible.

A pointer should be attached to the tail-water wire in such a position that it points to the center of the scale when the head is normal. Measure the head accurately with a tape line, or by other means and mark on the scale at the place indicated by the pointer; extend the scale as much as desired, and you will have a convenient gauge. Other scales may be placed near the wires at convenient points and adjusted so that you may know the inches or cubic feet of water flowing over the dam, or the loss of head due to rise of water in the tail race.

Loss of head in racks, gates or flumes can also be indicated in a similar manner.

FRED B. HUBBELL,
Westport, Conn.

Maintaining Cooling Water in Transformers.

We have a set of transformers, cooled by coils of iron pipe, through which water circulates. The coils are fed from the mail turbine feed-pipes, and at certain seasons of the year the level of head-race is liable to drop several feet below the highest points of cooling coils.

To avoid the collection of air at these points, and consequent interruption of flow, the discharge from the cooling coils is connected to one of our exciter draft-tubes, thus securing uninterrupted flow during all conditions, with no perceptible effect on steadiness of exciter vacuum or speed.

G. HARTMAN,
St. Gabriel, P. Q.

ELECTRICITY IN SUBMARINE MINING.*

The almost indiscriminate use of mines in naval warfare, as practiced by the two belligerents in the Far East, has gone far to illustrate the practicability of modern methods of exploding them, and not the least significant fact brought to light is the unsuitability of electricity where it can be avoided. The chief reason for this is liability to deterioration in the Leclanche cell, which even on open circuit is apt to run down in consequence of leakage.

Those who are accustomed to associate the Leclanche cell with the common house system of bell circuits will hardly realize this liability to deterioration, but it must be borne in mind that the conditions under which the cell has to carry out its functions are very different.

In the ordinary house circuit the wires are under cover and protected from damp, and even when they are exposed to the weather, they have the advantage of evaporation for drying purposes. Thus it is that the insulation is so perfect that leakage is practically a negligible quantity. It is very different in submarine mining.

To begin with, the type of cell used in the navy is of very low resistance; in the ordinary "boat's battery" type, which we have in mind, it is about two-tenths of an ohm, and therefore capable of giving a comparatively large current.

The cells are either made up into large batteries of about 80 cells, for use in controlling the mines from a shore station, or are placed in the mine itself, a pair to a mine; in the latter case the mines are self-contained, and are known as "electro-mechanical" mines. The circuit has only one break, known as the circuit closer, and is otherwise completed through the detonators.

The circuit closer is a form of mercury contact which acts when the mine is bumped. Now, when a mine has been laid out for some time, the interior of it, even supposing there to be no leakage of water through the joints, gets very damp, the iron case sweats a good deal, there is a certain amount of leakage, therefore, across the terminals of the battery, and this is assisted by the slight creeping of salammoniac, which, in spite of precautions, almost invariably takes place to some extent.

This creeping may, perhaps, be in a large measure caused by the tidal and wave motion to which the mine is subjected, causing the liquid to wash about and leave deposits above its normal level; the Japanese have, it seems, rather successfully used dry cells in spite of their liability to deterioration, and here we may, perhaps, digress for a space, to give our experience of the deterioration of dry cells stored under naval conditions. These cells, when their internal resistance has gone above a certain standard, are broken up as old zinc, and it is almost invariably found that the cause may be traced to local action in the zinc eating it away and covering it with scale.

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*From the "Electrical Review," London.

From whatever cause it may be, however, experience has shown that batteries used inside a mine deteriorate quickly, and are, therefore, unreliable after a certain length of time.

Batteries used outside a mine and on a circuit to be closed by a mechanical device inside it, run down through leaks in the submarine cable. The circuit here is invariably "earthed" through the steel armoring and so back through the sea water, and consequently the minutest leak soon develops.

It would appear, therefore, that electricity for automatic mines is doomed, and that its place will be taken by some purely mechanical device which will become released when the mine is struck, like the "horned" mines of the Russians; it is a pity that it should be so, for such mines, breaking adrift as many have done in the China Sea, become a lasting danger to shipping until they have been destroyed.

While speaking of mines and the application of electricity to them, it is curious to note that there have been proposals to fit them with zinc plugs, which, by galvanic action, eventually become eaten away and drown the explosive, sinking the mine, and thus putting it out of action.

South African Trade.

Advices from South Africa state there is no doubt that the scope for electrical enterprise is likely to expand in considerable proportions in the near future, so that American manufacturers should be on the alert for the expansion of their business throughout the sub-continent, now that a period of permanent activity has been inaugurated. At the present moment there is a growing demand for electric motors for lifts, the hydraulic lift appearing to have lost favor. In every new building electric elevators are being installed.

Like all other machinery in the Transvaal, electric motors are subject to Government supervision, and in order to establish uniformity in practice and to simplify the inspection work, a set of regulations for the construction and operation of elevators have just been drafted. These have not yet been put into force, but merely circulated in draft form for the information and comments of those professionally interested, prior to their legislation in generally acceptable form.

ENGLISH ELECTRICAL NOTES.

(From our London Correspondent.)

The Telephone Service in England.

The proposal of the British Government to take over the extensive telephone system of the National Telephone Company, which was referred to in these columns a few months ago, has been exhaustively examined by a special Parliamentary committee appointed for that purpose. The report of this committee has been issued to-day (August 1) and after carefully reviewing the agreement between the postoffice and the company effecting the purchase, the committee reports in favor of the acquisition by the State. The purchase, however, it is urged, must leave the position of municipal telephone systems unprejudiced, and municipal licenses may be granted between August, 1905, and December, 1911. Perhaps the leading point in the agreement which has called forth disapproval was the inadequate provision which was made for considerate treatment of the 14,227 employes of the National Telephone Company, when the system is taken over by the Government. In this regard it is satisfactory to mention that the committee recommend the Postmaster General to give an undertaking that no servant of the company, taken over by the Postoffice, shall suffer by the transfer in regard to pension. Such matters as the purchase price and the testing of plant in respect to its suitability for the requirements of the Postoffice telephone service, are to be submitted to arbitration if need be. But it is only on the understanding that nothing shall be done by the Government whereby the question of the future ownership and management of local telephone installations shall be prejudiced, that the committee recommends that the agreement shall come into force. If the Government finds time there is to be a discussion on the matter in Parliament within the next week or two, but in the event of that proving to be impossible, the agreement will take effect from August 31, 1905.

Liverpool Electric Railway Accident.

The disastrous collision which occurred at the Hall Road Station of the Liverpool-Southport Electric Railway on July 27, was not in any way an electrical accident. It was entirely due to the mistake of a signalman named Boote, who has made a full and complete confession of his error. When the reports of the disaster first began to spread all sorts of things were said about electricity, the design of modern electric high-speed rolling stock, the management of the railway, etc., by people who thought, as usual, they knew just where to put their finger on the spot where the chief weakness lay, but when the inquiry was opened the coroner took occasion to reprove the circulators of wild suggestions and impressed the jury with the fact that the disaster was in no way due either to the electrical equipment, the method of operation or to the management of the railway. The signalman, in error, allowed the express to pass at full speed on to a siding whereon a second electric train stood at rest, with the result that 20 persons were killed and a number injured. Londoners have lately become used to every slight mishap in a tube railway, or on the Metropolitan & District, being magnified in exciting and alarming terms in the "cheaper" newspaper press. These reports are calculated to give the public a want of confidence in electric railway traction, such as, it will be remembered, was evidenced on the electric tube railways after the Paris subway disaster. The Board of Trade is holding a full inquiry into the Liverpool collision and doubtless one of the purposes will be the proving that electric traction had nothing to do with the event.

London Electric Railways.

The work of electrifying the Metropolitan District Railway (London) is now practically completed. Electric trams are running between Ealing and Whitechapel, and from Harrow to Mill Park, and from Hounslow to South Acton. A service is also running between Kensington and Putney As cars are delivered further electric trains will be brought into running in substitution for the steam service. Both steam and electric trains are at present running over a portion of the Metropolitan system, and the cost of working has therefore been increased, but Sir Charles McLaren told shareholders the other day that this is quite unavoidable until the men get thoroughly used to the working of the electric trains.

Japanese Tariff.

The Japanese tariff of the present year provides that the dutiable value of imported articles shall be the actual cost of the articles at the place of purchase, production or fabrication, with the addition of packing charges, cost of transportation, insurance and all other charges incurred up to the arrival of the articles at the port of importation. In the event of an article under more than one rate of duty, it is to be assessed according to the highest of such rates. Special war taxes are imposed in some instances, and these became operative on July 1 of the present year, and are known to remain in force until one year after the close of the war.

Japan also levies varying rates of duty, having a general and a conventional duty; a consumption and a special consumption tax, and now the additional war tax.

The United States is classified with those having the "most favored nation" treaty, thus entitling her goods to entry at the conventional or lower rate of duty. It is also arranged that the war tax is not to be levied upon goods imported from those countries sharing the privilege of the most favored nation clause, *provided* they are accompanied with an authorized certificate of origin.

The following are the rates of duty of interest to the trade:

Electric light apparatus or instruments, and parts thereof, 10 per cent. ad valorem, war duty 5 per cent.

Telephones and parts thereof, 10 per cent., war duty 5 per cent.

Telegraph wire, galvanized, duty, 127 per cent. per 100 kins, of about 1⅓ lbs. each.

Telegraph wire, other than galvanized, 5 per cent. ad valorem.

Cars and carriages for street railways, 10 per cent. ad valorem.

Submarine telegraphic cables, and underground telegraphic lines or cables, duty 10 per cent.; war duty, 10 per cent.

New York Central's Sub-Station.

On behalf of the New York Central & Hudson River Railroad, C. A. Reed, architect, filed plans on August 8, for a two-story and basement brick electric sub-station, to occupy the south side of 50th street, extending over from the road's tracks at Park avenue to Lexington avenue. It will have a frontage of 361 feet in the street and a depth of 39 feet, and will cost $130,000.

This will be a most important sub-station, supplying electric power to the rails for the work of moving trains in and out of the terminal after the railroad's great improvements in New York are completed.

Some secrecy is maintained as to the exact plans of the road. It has bought a great deal of property along the east side of Park avenue, between 43d and 56th streets. This is the first definite information of the use it is to make of any of its property between Park and Lexington avenues.

Colorado Springs Searchlight.

A dispatch from Colorado Springs states that the electric lighting plant at the summit of Pike's Peak, has just been put in operation. The plant is operated by a 20 hp. gasoline engine. Work looking to the erection of a mammoth searchlight will at once begin, the rays from which when completed will, it is expected reach as far as the Kansas State line, a distance of 150 miles.

Morgan Construction Company's Catalogue.

The Morgan Construction Company, 40 Exchange Place, New York, is putting out a well prepared catalogue of its gas producers Much instructive information is given which heretofore has not been available to the public. An average efficiency of 92 per cent. obtained in tests made by Robt. W. Hunt & Co., give some idea of the progress that has been made in perfecting this producer. The catalogue contains fifty 6 x 9 pages with numerous illustrations. On the embossed cover is mounted a half tone of the producer printed in colors, showing the correct condition of the fire.

The Trumbull Switch.

The Trumbull Electric Manufacturing Company of Plainville, Conn., has just issued a supplement to its No. 5 Catalogue describing a Type A switch of a capacity of 1,200 amperes.

The greatest care has been exercised in selecting the material and in constructing this switch, and especial attention has been given to aligning the blades and jaws. After being perfectly adjusted, the blades are ground into the jaws with fine emery, to insure the smoothest contact surfaces. This adjusting is so accurate, and the contact so perfect, that these switches will continuously carry, without heating, a considerable overload.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 8, 1905

Electric Railways and Appliances.

796,482. Trolley. William P. Wiemann, Allegheny, Pa., assignor to the Empire Machine Company, Pittsburg, Pa. Filed Sept. 7, 1904.

796,501. Conductor-Rail Holder for Electric Railways. George L. Courtenay, New York City. Filed Feb. 14, 1905.

796,509. Car-Fender. Elwood C. Hall, New York City, assignor of one-half to Albert C. Woodworth, same place. Filed Dec. 5, 1904.

796,697. Trolley-Catcher. Seth J. Buckland, Springfield, Mass. Filed Jan. 30, 1905.

796,817. Trolley Appliance. Frank P. Criner, Fort Wayne, Ind., assignor of one-third to Charles W. Stein, same place. Filed Dec. 19, 1904.

796,869 Trolley-Wheel. John C. A. Riecke, Baltimore, Md. Filed Jan. 14, 1905.

Electric Lights and Appliances.

796,467. Electric-Arc Lamp. Bernard A. Stowe, Cleveland, O., assignor to the Jandus Electric Company, same place. Filed Dec. 5, 1902.

796,629. Lamp-Guard. Thomas A. Edison, Llewellyn Park, N. J., assignor to the New Jersey Patent Company, Orange, N. J. Filed Aug. 1, 1903.

796,749. Electric Car-Lighting. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car Heating Company, same place. Original application filed Feb. 20, 1899. Divided and application filed Sept. 9, 1901. Again divided and this application filed Oct. 6, 1902.

796,757. Electric Incandescent Lamp. William J. Phelps, Detroit, Mich., assignor to the Phelps Company, same place. Filed April 25, 1902. Renewed June 5, 1905.

Electrical Machinery and Apparatus.

796,474. Motor-Control System and Switch Therefor. Leonard A. Tirrill, Lynn, Mass., assignor to the General Electric Company. Filed April 15, 1903.

796,483. Feed-Regulating Device for Electric Motors. Seward W. Williams, Lapeer, Mich. Filed June 1, 1903.

796,491. Electrical Stop-Motion for Warping Machines. Richard C. Borchers, Philadelphia, Pa. Filed Dec. 12, 1904.

796,512. Extension Circuit-Closer. Jacob R. Hershey, Keokuk, Ia., assignor, by mesne assignments, to the Electrical Devices Company, same place. Filed Dec. 7, 1901.

796,555. Apparatus for Distributing Alternating Currents. Arthur F. Berry, Ealing, Eng. Filed Nov. 6, 1903.

796,606. Electromechanical Regulator. Joseph L Routin, Lyon, France. Filed July 17, 1901.

796,637. Combined Electric Motor, Rheostat, and Belt-Tightener. Herman S. Graber, St. Louis, Mo. Filed Dec. 8, 1904.

796,646. Time-Limit Circuit-Controller. Edward M. Hewlett, Schnectady, N. Y., assignor to the General Electric Company. Filed May 12, 1903.

796,675. Recording Instrument. Maurice C. Rypinski, New York City, and Lewis T. Robinson, Schenectady, N. Y., assignors to the General Electric Company. Filed March 30, 1903.

796,687. Circuit-Controller. Howard B. Wilson, Schenectady, N. Y., assignor to the General Electric Company. Filed April 18, 1903.

796,748. Power-Transmitting Mechanism. Wallace Marshall, Lafayette, Ind. Filed July 2, 1904.

Telephones and Telephone Apparatus

796,441. Telephone System. Kempster B. Miller, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company. Filed Feb. 4, 1901.

796,562. Telephone Call Mechanism. Tracy R. Campbell, Aberdeen, S. D. Filed Jan. 14, 1905.

796,568. Telephone System. William W. Dean, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed Oct. 27, 1902.

Miscellaneous.

796,435. Secondary Battery. Jacobus Langelaan, Oberschoneweide, near Berlin, Germany, assignor to the Pfluger Accumulatoren-Werke Actiengesellschaft, same place. Filed Feb. 27, 1905.

796,517. Battery-Holder for Automobiles. Frank Jackson, Denver, Col., assignor to the Jackson Manufacturing Company, same place,. Filed Sept. 27, 1904.

796,533. Electric Bath-Robe. Edwin B Rayner, Piqua, O., assignor to Clark B. Jamison and William J. Prince. Filed Oct. 2, 1902. Renewed Jan. 27, 1905.

796,550. Lightning Protector for Buildings. John P A. Anderson, Madrid, Iowa. Filed Sept. 20, 1904.

796,559. Electric Sign. Charles T. Bradshaw, Philadelphia, Pa., assignor to the Attracto Company, same place. Filed March 17, 1902. Renewed Jan. 18, 1905.

796,595. Telephonic Transmitter. Alexander Muirhead, Shortlands, Eng. Filed April 27, 1899.

796,596. Electric Telegraphy. Alexander Muirhead, Shortlands, Eng. Filed Oct. 14, 1901.

796,597. Telegraphic Receiver. Alexander Muirhead, Shortlands, Eng. Filed Dec. 13, 1901.

796,684. Electric Heater. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed Jan. 13, 1905

796,701. Electric Clock. Ragnar Carlstedt, Jersey City, N. J. Filed Sept. 1, 1904.

796,760. Lightning-Conductor. Frank E. Price, Chicago, and William H. McCullough, River Forest, Ill. Filed March 6, 1905.

796,800. Receiver for Use in Wireless Telegraphy. Edouard Branly, Paris, France, assignor to Victor Popp, same place. Filed Sept. 4, 1902.

796,851. Ruhmkorff Coil. John McIntyre, Jersey City, N. J. Filed Dec. 8, 1904.

796,872. Electroplating Device. Henry Schuessler, Peru, Ill., assignor of one-half to Emil Stroemer, same place. Filed Sept. 17, 1904.

796,977. Insulator-Pin. Fred M. Locke, Victor, N. Y. Filed Sept. 25, 1902.

THE TELEPHONE WORLD.

Independents add Another Link to Chain.

The Rochester, N. Y., telephone syndicate has secured the controlling interest in the Rome Home Telephone Company by purchases of Elyria, O., and Albany interests. For some time past the Rochester company has had an option which expired on August 1, and verification is now made through the Utica office of the Independent Telephone Securities Company that the option has been accepted and a transfer made. As in the past the management of the Rome Home Telephone Company will be under the direction of a local board of directors. The rumors that the Rochester company is buying up the interests of the Independent telephone companies for the Bell people are pronounced by Rome telephone people to be absolutely untrue. The Independents are working to establish a line across the State into New York City, and are said to be meeting with every encouragement.

Independent Telephone Meeting.

Representatives of all the Independent telephone companies in Illinois were gathered in Peoria last week for the purpose of forming a powerful organization, the object of which is to fight for business in that State.

It is proposed to connect all the Independent companies in the State by toll line, the ultimate object being to make a bid for interstate business. James D. Hoge, president of the National Association, delivered an address on "State Organization." Representatives were present from Michigan, Missouri and Iowa Four hundred delegates were in attendance.

A report from Concordia, Kan., states that the interest in the telephone question is at a remarkably high tide among the farmers. Their desires and undertakings now are, not only to join a few small lines and then ask for a franchise, but to thoroughly organize and incorporate a United Farmers' Company of Cloud and Republic Counties.

The Hattiesburg, Miss., city council has granted a franchise to J. A. and S. A. Jones and George D. Winter, of Chicago, to build an underground telephone system at a cost of $125,000. The franchise is to run for 25 years, and work to begin in 30 days.

The Clinton, N. Y., Home Telephone Company has moved into new quarters. A new switchboard has been installed which will accommodate 1,000 subscribers.

The Independent Telephone Company of Syracuse, N. Y., has ordered a switchboard costing nearly $200,000, and it will accommodate 12,000 telephones. Each telephone will be on a direct line.

The West Terre Haute, Ind., Telephone Company, capitalized at $10,000, has been formed with the following directors: Burton Cassaday, S. S. Gosnell and H. H. Knipe.

The automatic telephone system is being installed in Wilson, N. Y.

Independents Seek Telephone Franchise.

The applicants for the West Shore Telephone & Telegraph Company franchise were given their first hearing about two months ago before the judiciary committee of the common council of Milwaukee, Wis. There were present at the meeting Don Farnsworth, of Boston; Julius Simon and Attorney John W. Wegner, legal advisor of the company.

After a general statement of the parties seeking the franchise, the committee decided to go through the ordinance section by section, which was done immediately. Several changes were proposed by the aldermen to which the promotors readily consented. However, after the committee finished reading the ordinance it was decided to defer action until the second company, which applies under the name of the Milwaukee Home Telephone Company, has been heard on its application. This company is not in any way identified with the West Shore Company. Its backers are James B. S. Brailey, Jr., of Toledo, O., and Clifford Arrick, of Indianapolis, Ind. Mr. Brailey, is an experienced telephone contractor, having built several large Independent exchanges, among them the plant in Kansas City.

The Independent telephone companies operating throughout the State are also backers of the pending franchises as it is claimed by them that their cause will be helped materially if the Independent telephone movement gets a foothold in the metropolis of the State.

It is not expected that any report will soon be made to the council as both ordinances will be thoroughly considered before definite action is taken.

New Telephone Line for Michigan.

Walter Blodgett, of Detroit, has been in Benton Harbor lately, taking subscriptions for a new Independent telephone company that will be started in that city.

The new company will be known as the Standard Telephone Company, and will have lines and stations in St. Joseph, Grand Rapids and South Haven, in addition to the Benton Harbor exchange.

Mr. Blodgett says that he is meeting with encouragement in securing contracts from subscribers. The new company has retained the services of Attorney W. C. Hick. Since the consolidation of the Twin City Telephone Company with the Michigan line over a year ago, service in the two cities has been very poor and business men will welcome competition that will inaugurate a good service.

The Racket River Telephone Company has under way a complete remodeling of its system in Potsdam, N. Y., and when it is completed that town will have as fine a telephone service as modern machinery and methods can produce. An entirely new system will be constructed, and when it is ready for operation the old one will be removed. The work of erecting the poles will begin at once.

It is understood that Mrs. Brett, of El Paso, Tex., will make application for a franchise to conduct an Independent telephone system in Anniston, Ala.

Sale of Telephone Company.

The Commercial Telephone Company of Austin, Tex., has been sold at auction to a commitee representing the bondholders consisting of J. A. Quisinberry, of Danville, Ky., chairman; J. H. Gerke, of Wapakoneta, O., and Fred Bimel, of Portland, Ind. The franchise itself sold for $60,000, while the apparatus, fixtures, etc., and the company's lines in Texas brought $50,000, making a total of $110,000.

This sale was the result of a suit instituted by the bondholders to obtain the interest on $400,000 of the telephone company's bonds. The company, being unable to pay this interest, was put into the hands of a receiver, and Mr. George Shelley was appointed master in chancery with directions to foreclose the mortgage or deed of trust held by the bondholders and to sell the property to the highest bidder at an auction sale.

At the annual meeting of the New Brunswick Telephone Company, held in Fredericton, N.B., it was decided to erect a number of lines during the present season. They will include a line from Chatham to Dalhousie, connecting with Bathhurst, Campbellton and other places along the North Shore; also a line from Canterbury to McAdam, another from St. Stephen to Moore's Mills, and from Lepreau to Musquash, The company also decided to connect with the Kamaraska Telephone Company, by extending the line to Edmunston. A $6,000 brick building will be erected in Fredericton for the use of the company's head offices.

At a recent meeting of the board of directors of the Toledo, O., Home Telephone Company a voting trust was organized to remain in existence until 1910. The purpose of the trust, which will contain 70 per cent. of the stock, is to keep the local Independent plant from falling into outside hands or into the control of unfriendly interests. The trust is composed largely of the directors of the company.

Thus far 300 telephones in Columbus, O., have been placed in connection with the recently installed automatic switchboards. Officers of the company say it will require eight or nine weeks further to make the complete connections.

Postmaster, Willcox, of New York, has been touring Europe to study the postal systems in the larger cities, and says the London telephone service is much worse than it is in small towns in the United States. London has the finest mail service in the world, but New York leads in the use of pneumatic tubes.

The State Board of Valuation lately passed on the Citizens' Telephone Company of Covington, Ky., and fixed its total capitalization for franchise tax purposes at $200,000. The franchise value will be that amount less the tangible property already assessed by the city assessor.

The telephone business in Louisiana and North Carolina is under the control of the Railroad Commission.

The Independent telephone companies are giving excellent service in and around Lebanon, Ind.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Boston, Mass.—An order has been issued by the gas and electric light commissioners in this city approving the issue of $5,000 of new capital stock by the Huntington Electric Light Company for the purpose of purchasing the electric lighting plant and business in Huntington formerly owned and operated by ex-Representative Henry E. Stanton.

Cincinnati, O.—The board of aldermen has adopted an ordinance introduced by Mayor Helmbold that provides for the submission to the voters at the coming election the question as to whether or not bonds, amounting to $50,000, shall be issued for the purpose of erecting a municipal electric light plant.

Citronelle, Ala.—The Business Men's Association, of which C. W. Thomas is secretary, will consider propositions for the establishment of an electric light plant.

Clinton, Ind.—The Clinton Electric Light & Power Company has been reorganized. The new officers are: D. McBeth, president; H. C. Dies, treasurer; J. W, Robb, secretary and manager.

Ft. Dodge, Ia.—The Illinois Central is contemplating the installation of an independent electric lighting plant in this city.

Greenfield, Ind.—The city council has decided to repair the electric light plant and at the last meeting ordered Superintendent E. C. Wolfe to proceed with the work.

Laramie, Wyo.—Superintendent W. A. Whitney, of the Union Pacific, who is in this city, said that there was more than a possibility of that company installing its own electric light plant here.

Lock Haven, Pa.—The Electric Light Company of this city contemplates enlarging its plant on East Church street.

Mt. Vernon, O.—Carl Hoster and Samuel Blumenthal, of the Hoster Brewing Company, have been here looking over the property owned by the Hoster Company. It is understood that the company intends to install a large electric plant.

Philadelphia, Miss.—The Philadelphia Compress Electric Light & Ice Company, has been incorporated with a capital of $30,000.

Princeton, Wis.—The proposition for this village to purchase an electric light plant was recently carried.

Urbana, O.—Architect William Miller, of Springfield, is preparing plans for the $5,000 electric lighting plant to be erected here.

Womelsdorf, Pa.—Plans have been prepared by William H. Dechant, engineer, of Reading, for the erection of an electric light plant for this borough.

STREET RAILWAYS.

Atlanta, Ga.—Charles J. Canfield, of Chicago, a millionaire electric railway man, and other Northern capitalists, together with several local parties, have been granted a charter by Secretary of State Phil Cook to construct a trolley line from this city to Macon, a distance of about 100 miles. The concern will be known as the Atlanta-Macon Interurban Railway Company and will have a capital of $100,000. The line will run through Fulton, Clayton, Henry, Spalding, Pike, Monroe and Bibb Counties. The construction of the new line will be begun within the next few weeks, the praliminary survey having already been made.

Belmont, O.—The Belmont Electric Street Railway Company has been incorporated with a capital of $300,000 by James F. Anderson and John DuBois.

Canal Dover, O.—A proposed electric line from this city to Lisbon or Salem is being agitated.

Chattanooga, Tenn.—The Chattanooga Electric Railway Company, it is stated positively, will construct a trolley line up Lookout Mountain in the near future. Conservative contractors state that the entire track from the bottom to the top of the mountain can be built for a sum not to exceed $25,000.

Dallas, Tex.—Plans are being quietly developed that will mature in the near future for the construction of an interurban electric road to extend between this city and Sherman.

Fremont, O.—Articles of incorporation have been prepared by Capt. D. H. James for a new railway company, which plans to have a through electric car service between Toledo and Columbus.

Kalamazoo, Mich.—Arrangements have been completed for an electric line from Battle Creek to Gull Lake and Grand Rapids.

Lawrence, Kan.—A meeting of the stockholders of the Kansas City, Olatha, Lawrence & Topeka Electric Interurban Railway was recently held here. All the business of the company was brought up-to-date, and arrangements were made for pushing the work of construction rapidly. Lawrence people at least are convinced that the road is a certainty and will be built the entire length that has been talked of. The directors of the company are: A. Monroe, Eben Baldwin, J. N. Roberts; A. F. Hunt, Jr., J. M. Belknap and F. O'Flaherty.

Marinette, Wis.—Menominee, Marinette and Crystal Falls capitalists are back of an electric railway which will connect this city and Escanaba.

Montgomery, W. Va.—A new electric railroad is projected in Fayette County, to run from Fayette Station to Fayetteville, the county seat, up the mountains upon which the town is located. It will be about 8 miles long.

Muscatine, Ia.—Local and Burlington capitalists have decided to build an interurban line between the two cities.

Opelika, Ala.—It has been officially announced that contracts have been let and preparations made for constructing an electric car line between this city and Auburn, for which 10 miles of track will have to be laid. The capacity of the Opeilka electric plant will be increased threefold to furnish power for the road and light and power for this city and Auburn. The company is capitalized for $300,000. Work of construction is to begin about September 1.

Paw Paw, Mich.—A movement is on foot looking to the speedy construction of a new line of railroad between this place and the village of Lawton. The Kalamazoo, South Haven & Chicago Traction Company, in connection with the Michigan Central, are back of the project.

Saratoga, Wyo.—Plans are now being formulated here for the construction of an electric railroad connecting this city with the Union Pacific at Walcott, and steps are being taken to form a company composed of prominent business men of this city and ranchmen and farmers in this vicinity and along the route of the proposed road. The line will be about 40 miles in length and capable of handling the freight as well as the passenger business.

Shelbyville, Ky.—The promoters of the Shelbyville & Ohio River electric line have announced that the bonds for building the road have been floated in the East, and that the road will be built. The survey makes the length of the route 50¼ miles. Milton, Ky., opposite Madison, Ind., is the starting point. Thence it will run to Carrollton, Campbellsburg, and from there to New Castle, thence to Eminence and this city.

South Bend, Ind.—Charles F. Knowlton, of Indianapolis, has met local business men with a view of interesting them in an electric railway line which is proposed from Ft. Wayns to this city.

Terre Haute, Ind.—P. Chase, of Decatur, Ill., C. W. Mills and H. C. Kohn, of Chicago, have asked the county commissioners for a franchise to erect a traction line over the new Wabash River bridge.

Vermilion, O.—It is generally believed that this city is soon to have a new electric railway.

Youngstown, O.—An effort is being made to have the Shenango Valley Traction Company build a branch to New Wilmington.

POWER PLANTS.

Hamilton, O.—B. S. Hughs, consulting engineer, of Wyoming, O., will superintend the construction of the 9,600 hp. plant for the Champion Coated Paper Company in this city.

North Wilkesboro, N. C.—The Gordon Manufacturing & Power Company of this city has been incorporated with a capital stock of $20,000 for the purpose of operating a plant for generating electricity for light and power, and operating electric railways. The incorporators are: J. Gordon Hackett, Richard N. Hackett and H. W. Gwyn.

Reading, Pa.—The Reading Illuminating Company is making active preparations to erect a power plant. The incorporators of the new company are Gustave Uldricht, Ralph W. Difford and others.

BIDS WANTED.

Omaha, Neb.—Sealed proposals for an electric lighting system will be received until 10 A. M. August 21, at the Fort Omaha Constructing Quartermaster's Office.

Washington, D. C.—Sealed proposals will be received at the Treasury Department Office of the Supervising Architect, James Knox Taylor, until 3 P. M. August 22, and then opened for the installation of an electric passenger and freight elevator in the West Outbuilding, Bureau of Engraving and Printing in this city, in accordance with drawings and specifications, copies of which may be obtained at the office at the discretion of the Supervising Architect.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15⅜@15½c.; Lake 15⅜@15½c.; casting, 14⅞@15⅛c.

Mayor Weaver of Philadelphia is advertising for bids for electric lighting next year.

The American Telegraph & Cable Company will pay the regular quarterly dividend of 1¼ per cent. on September 1.

People in close touch with the two big electric companies declare that the relations between General Electric and Westinghouse seem now to be harmonious.

Advices, largely authoritative, indicate the existence of a plan for a great subway and elevated system covering the whole city of Pittsburg and tapping Allegheny.

The stockholders of the Citizen's Telephone Company, of Grand Rapids, Mich., have voted to increase the capital stock from $2,000,000 to $3,000,000, to provide for additions and extensions.

H. H. Gerry, Jr., general manager of the Missouri River Power Company, of Helena, Mont., announces that the Light & Traction Company's property in that city has been sold to J. G. White & Co. of New York.

The Pittsburg & Butler Street Railway Company has awarded the contract for constructing its trolley line from Etna to Butler, Pa., to the Ferguson Contracting Company of Pittsburg. The amount involved is about $1,000,000.

The American Railways Company (Philadelphia) declared the regular quarterly dividend on the stock of 1½ per cent., payable September 15, to holders of record August 31. The annual meeting of the company will be held on Thursday, September 21.

The stockholders of the Hartford, Conn., Street Railway Company will meet on September 6 to act upon a proposition to sell its contract, property, rights, privileges and franchises to the Consolidated Railway Company and distribute the net proceeds among its stockholders.

The Metropolitan Street Railway Company of New York reports gross earnings for the month of July of $1,892,689, an increase of $79,400 over those of July last year. The earnings for last month were the largest for any July in the history of the company.

The Brooklyn Rapid Transit's gross earnings for the fiscal year are expected to approximate $17,500,000. A rumor to the effect that the company had or would declare a 2 per cent. dividend is absolutely denied by the controlling interests, who state that it is the policy of the company to steadily improve the road in all departments and to perfect the system.

President A. G. Wheeler, of the Chicago Subway Company, writes as follows about the future of the company: "There has been much adverse comment on Subway stock, but it does not affect the value of the security, which will not be purchasable, probably some time next year under 200, and in course of time not at all. Insiders are content to pick up all the stock that is offered."

The Consolidated Railways Company of Connecticut, which controls 525 miles of electric railway lines, showed net earnings for the year ended June 30, over and above all charges, of $426,000. The capital stock of the Consolidated Railways Company is $10,000,000, all but 15 shares of which is owned by the New York, New Haven & Hartford Railroad Company. At this ratio the investment yielded the New Haven a trifle better than 4½ per cent.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price Aug. 14
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	218⅛
Manhattan Elevated Railway	167¼
Metropolitan Street Railway	128¼
Metropolitan Securities	88
Ninth Avenue	197
Third Avenue	128⅛
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	73¼
Brooklyn City Railway	239
New Orleans Railway	30¼
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	82
Philadelphia Traction	100
Union Traction	60
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	19⅛
do. do. do. pref	62
West End Street, com	97½
do. do. do pref	114½
Chicago.	
City Railway	190
North Chicago	63
Union Traction, com	9¼
do. do. pref.	87
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	17⅜
do. pref.	84⅛
Electric Boat, com	32
do. do. pref.	72
Electric Vehicle, com	18
do. do. pref.	20
Westinghouse, com	171
do. pref.	190
General Electric	184⅝
Boston.	
Edison Electric Illuminating	256
General Electric	184⅛
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	157½
National Carbon, com	60⅞
do. do. pref.	118
Philadelphia.	
Electric Company of America	11⅛
Electric Storage Battery, com	82
do. do. do. pref.	82
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	141⅛
Western Telephone Company	17½
New England Telephone Company	188
New York.	
American Telegraph & Cable Company	190½
Commercial Cable Company	210¼
Mexican Telephone Company	½
New York & New Jersey Telephone Company	172⅛
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93¼
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Chicago Subway	86¼
Otis Elevator Company	66
Standard Underground Cable	..
Twin City Rapid Transit	118⅜

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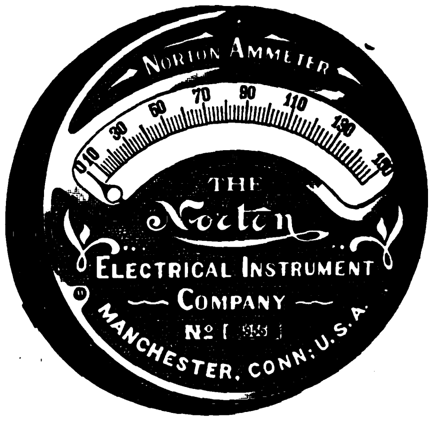
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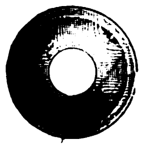

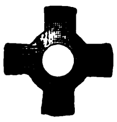

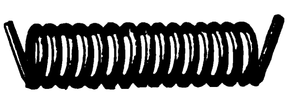

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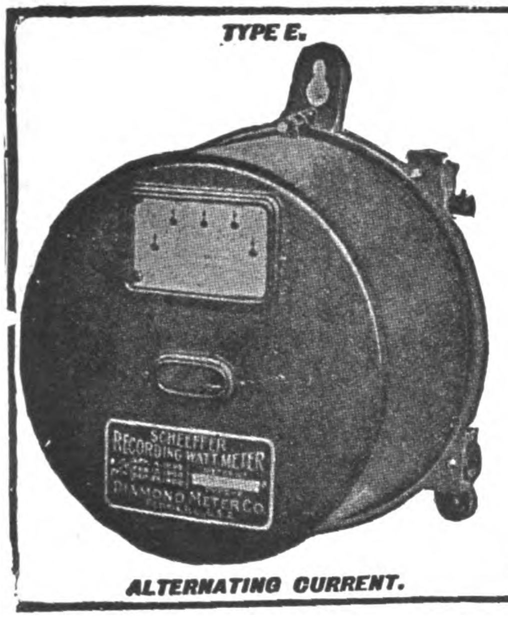

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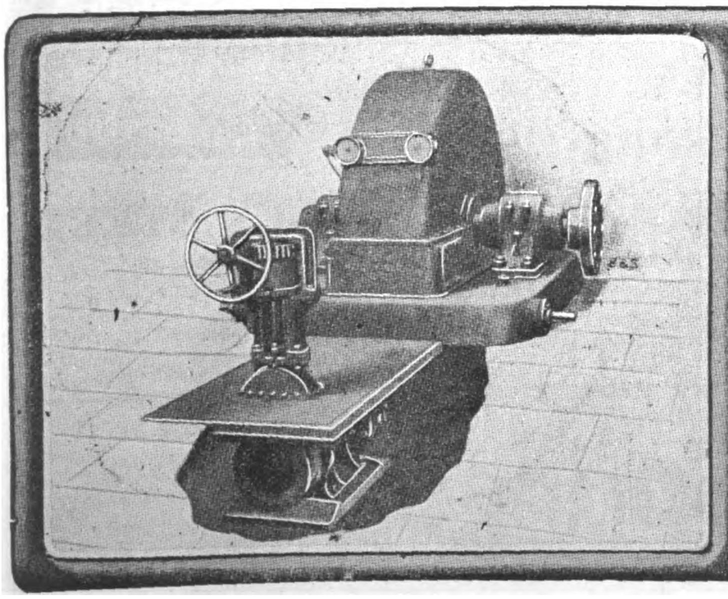

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ELECTRICITY.

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EDITORIAL NOTES.

Single Phase Street Railways.

Alternating currents first came into use experimentally, and for a considerable period belonged to the questionably applicable uses of electricity. The simple single phase current now threatens to gain much of its lost prestige, through its use in street railway work. A series motor is so constituted that a direct current will operate it in the same direction, whether it is reversed or not. An alternating current, in consequence, will not have any different effect upon it, from a direct current whose poles are being constantly reversed. The provision that must be made in such a case, however, is that the reactance within the machine will not be such as to interfere with the proper flow of current; otherwise the motor will be bulky and unwieldy, out of all proportion to its output.

Single phase motors of the series wound type are therefore the exponents of a new principle. They belong to a new series of possibilities in the electrical field. With the use of laminated frames, the correct proportioning of the turns on armature and field, and some care in the method of starting, it is quite easy to understand why this type of motor may usurp the so-called D. C. type in such cases as those requiring a long string of feeders to carry the proper potential to the various points of the trolley line. The single phase motor is not itself the only feature of value in this newly introduced system of electric propulsion, but the accessories of the system. The transformer takes the place of the feeder, in that its presence in the car lowers the higher tension of the trolley wire and tracks to the less dangerous pressure required. The economy in copper thus becomes an important feature; one that may lead to its greater adoption for comparatively feederless long distance trolley lines.

* * *

Saving in Machine Shops.

Machine shops in the United States are predisposed to improvements. They are the most progressive of all our institutions. They are places where a man's time is valuable enough to call for as much care in its utilization as circumstances will permit. Every hour of time saved by the intelligent manner in which work is done not only means profit to the shop but it means as well a reputation for dispatch. For this reason the machine shop has become the scene of the use of automatic appliances. It has become a true engineering center in which is focused the inventiveness, skill and labor of the best class of our constructors. And in addition, it has led to the investigation of certain important problems in shop economy which relate to the cost of turning out work, and in some respects, to the time as well. The features of this kind, to which attention is directed, are those of shaft and belt friction, and the cost of this manner of transmitting and distributing power, in comparison with the more up-to-date method of using individual motors for each machine. Tests of the efficiency in the first case gave rise to an interesting series of results, among the most important of which was a surprisingly high figure for the wasted power. This, as may be imagined, was only due to the friction developed by the stiff belts and countershafts employed in these shops, and it is not difficult to trace this waste again to the thickening of oil in the bearings and the change in the flexibility of the belting. In a shop using 1,000 hp., the countershafting consumes nearly 400 hp. From a dollar and cents standpoint, estimating the cost of a horse power at $50 a year, the extent of this loss can be measured up in the annual waste of $20,000. An installation of motors would naturally represent a greater expenditure in the first place, but the efficiency would readily average over 80 per cent. net and perhaps 90. From this standpoint, a saving of over $10,000 appears. A saving of this kind certainly warrants an investment of at least five times as much, or $50,000, in electrical transmission machinery. Machine shop saving in this respect, in large shops at least, means a profit in the operating expense. Modern machine shop practice is a scientific as well as a financial and mechanical proposition.

* * *

British Electrical Manufacturing.

The electrical engineering industry in England has not experienced that complete return to prosperity which was foretold by those who were of an optimistic turn of mind a year ago. According to our London correspondent, complaints are loud and continued regarding the undercutting and other effects of the severe competition which has existed in the electrical trade during the last few years. But for the heavy demands for money for the South African war, there might have been no difficulty either on the part of municipal authorities or private companies in securing financial support from public investors to help to maintain the previous excellent rate of development in electric lighting, power and traction directions, and to lead to still farther reaching developments.

If nothing had occurred to hinder the progress, there would have been plenty of work going for all electrical manufactories in Great Britain, not excluding the works established by American and Continental firms on English soil. This would have been the more assured by reason of the increased requirements of South Africa, Australia, India and other British colonies, which were becoming large customers for electrical material and machinery. But the South African upheaval, and the monetary tightness, not only stopped development in England, but to some extent closed certain foreign markets temporarily as well. It is taking a long time for these effects to pass off, and the recovery process, though its signs are becoming more evident, is not developing at such a rate as to permit electrical industrial companies to recover their lost ground and pay their way.

Two things are needed to effect the salvation of some of these concerns, and they are very closely related: the letting loose of money for industrial and engineering works, and the stopping of the ruinous undercutting of prices which has characterized every department of electrical work of late. Given the former, the latter would shortly follow because of the increased volume of business. Efforts have been made in some departments to bring firms dealing in certain lines together, effecting "understandings" for maintenance of prices which should show a profit. This has, we believe, happened in regard to motors, generators and engines, while the cable makers have an organization of their own. The profits on electric car building, too, have been so finely cut that during the last six months three big works in this line have amalgamated and ruinous competition has been stopped for the time being. Most of the leading electrical manufacturing firms have issued annual reports recently, and these show no improvement on the returns for the previous year. Some firms who managed to struggle on through troubles in earlier years have of late succumbed through the over-lateness of the electrical awakening.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The telegraph operators are among the busiest people at the peace conference at Portsmouth, N. H. On the average 12,000 words a day have been cabled to Europe and Japan.

It is estimated that over 100,000 people witnessed Knabenshue's airship sail over New York City Sunday afternoon from Central Park South to 46th street and back. The aeronaut was up 1,000 feet in the air and traveled more than two miles, steering the airship with perfect ease.

Chief Engineer Wilgus has informed the New York Central directors that the change in motive power from steam to electricity for operating trains between 42d street and Woodlawn can be made within 12 months. Complete equipment of all steel non-inflammable cars, 50 feet in length, with electric fans for proper ventilation and an improved third-rail, have been fully arranged for. The improvement under way, including the new terminal at 42d street, with electric power plant, etc., will cost about $40,000,000.

Mr. Martin Brill of Philadelphia, who has been chosen president of the new street car merger, has demanded that the financial managers provide $2,000,000 more cash than the original plan called for. His demand will probably be granted.

A new scheme is said to have been successfully tried on a small scale in Madera County, Cal., for exterminating grasshoppers. A strong electric light is placed in a shallow trough containing a mixture of oil. The grasshoppers congregate and the oil kills them. Farmers who have employed this light method say that it promises to be most valuable, as only a few lights are needed, and these attract the grasshoppers in immense numbers from long distances.

The Philadelphia Electric Company was the only bidder for the electric lighting for that city for 1906. In every instance its bid was 3 cents per light per night less than the current rate, making a saving to the city of $118,000 per annum.

The Southern New England Telephone Company is planning to build roadside telephones on the more commonly traveled routes between New York and Boston for the use of automobilists. The telephones will be inclosed in boxes and automobilists will be given keys.

It is announced from Berlin, says the "Electrician," London, that more stringent regulations are to be imposed with regard to the admission of foreigners to German universities. It appears that the matriculation examination imposed on attending students is in most cases a pure formality. In the case of German students this certificate, obtained on leaving the "Gymnasium" or "Real Gymnasium," conferred the right to study at any technical university, and a certificate from any scholastic institution of equal rank with these, accompanied with a duly-attested passport, was considered sufficient in the case of foreign students. Now the following regulation has been issued and will come into force at the beginning of the next college term: "The conditions of admission for Germans apply also to foreigners, but in the case of the technical university at Dantzig special permission must be obtained from the Minister for Public Instruction before any foreign student, even though he fulfill all these conditions, is admitted."

Chicago's local transportation committee will take up the Mayor's 270-mile municipal railway plan next Monday and endeavor to agree on a system of transportation to be constructed and operated by the city in competition with the existing companies. It is estimated that the Mayor's system will cost $25,000,000.

THE MODERN PRINTING PRESS ELECTRICALLY DRIVEN.

BY FRANK C. PERKINS.

Where new printing establishments are being designed and constructed a direct-connected electrically-operated printing press is extensively employed as best meeting the requirements, but where existing plants are to be re-designed and arranged for electric driving, belt connections are very often found necessary between the motor and the driving pulley of the presses. A number of methods have been adopted for applying motors to printing machinery, the silent chain, gear and friction drive being utilized, as well as those mentioned above. The accompanying illustration, Fig. 1, shows an electrically-driven Babcock "Optimus" press, being operated by an electric motor with belt transmission and an idle pulley, while Fig. 2 shows a direct-connected Sprague motor driving a Cottrell four-color rotary press.

During recent years electricity has been introduced as a motive power in the printing press rooms of America, as well as Europe, to such an extent that these portions of the printing establishments are now models of neatness and cleanliness. The many countershafts and transmission belts have been entirely done away with, thus avoiding numerous dangers and difficulties arising from this method of transmitting power to the presses and other machinery utilized. There has been remarkable progress in the development of the electric motor and special controllers, systems of electrical control having been devised to successfully operate all classes of machinery used in the printing and allied trades.

It is now generally acknowledged that electrically operated printing presses are most economical in small as well as large plants, and many establishments have been able to reduce their operating expenses to a considerable extent as well as to greatly increase the output. The up-to-date printer realizes the importance of adopting modern methods to successfully cope with present keen competition, and therefore take the advantage of economical and labor-saving machinery wherever possible. Electric motors are specially suitable for driving this class of machinery on account of the ease of control, the efficiency and the cleanliness, as well as economy of space as compared with belting and shafting, resulting also in an increase of product at decreased cost.

Operating printing presses and other machinery of this class by the old method of countershafting and overhead belt has been discarded in many printing establishments on account of clean jobs being spoiled by the drippings of oil and accumulation of dirt on the overhead hangers and belts. The step-pulleys on the countershafts also limit the proper operating speeds of the various machines, owing to the extreme variation from one step to the other. It is also necessary where the old method is followed for the machines to be placed in arbitrary rows, in line with the overhead shafts; this involves a tremendous loss of power operating the many countershafts and idle pulleys, which varies from 40 to 60 per cent of the total power consumed, and also the possibility of a complete shut-down due to the breaking of a belt or lacing, upon which the motion of a number of machines is dependent. This explains a few of the most important and objectionable features of the old form of power transmission.

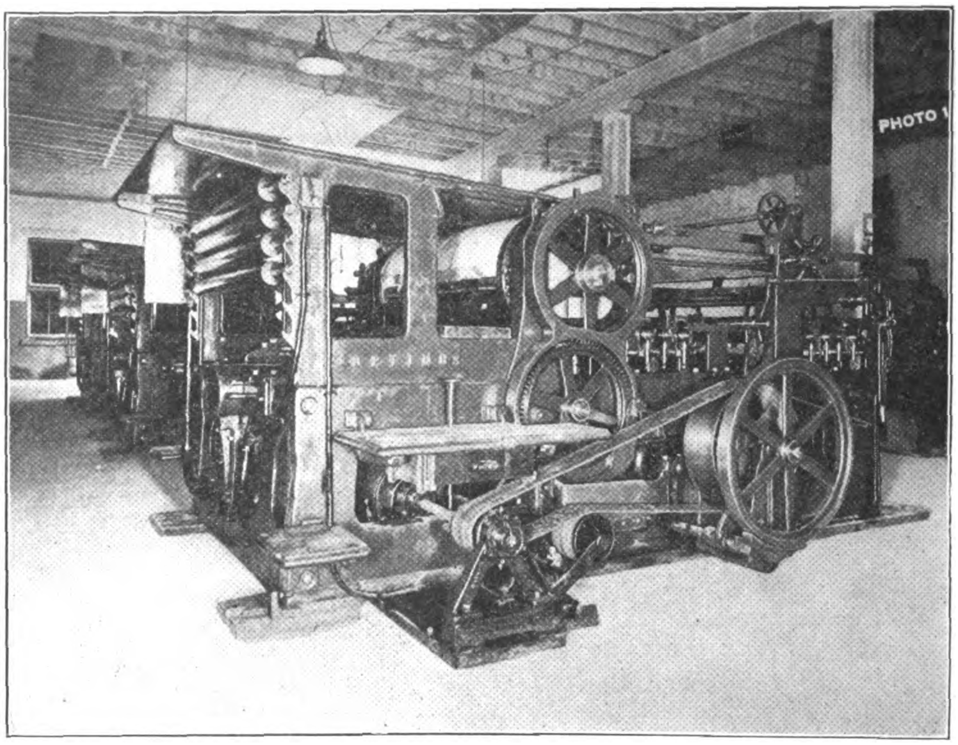


Fig. 1.—Electrically-Driven Babcock "Optimus" Press.

It is well known that electric motor-driven machines are clean because there are no overhead belts to throw dirt and oil. The motor and the machine it drives constitute an individual unit that may be placed in any desired position, because there are no lines of shafting and belts to be considered. As the power from the motor is transmitted directly to the machine without the use of intermediate shafting, the loss of energy in the shafting is saved. The operator has absolute control of the motor when in use, and is able to start, stop or regulate the speed instantly by the mere movement of a small lever or handle. Each machine and motor being a unit and independent of other machines prevents the necessity of shutting down an entire line of machines if one should fail, as frequently happens in establishments equipped with shafting. Moreover, it is unnecessary to supply power for the whole plant when only one unit is in service, as the moment the motor is stopped on the machine in use all expenses for current on that particular machine cease. This is an important feature, especially for machines, which are operated for short periods, such as make-ready, cleaning or changing form, etc., on the press.

In some cases belt transmission is found absolutely necessary, and the application of a motor to a machine by belted connection consists of either supporting the motor upon substantial brackets attached to the machine, or in a suitable locality, in such a position that the motor pulley will be in line with the pulley on the main driving shaft of the machine. A high grade belt, preferably "endless," is used for connection between the motor and machine pulleys. In applications of this character, where the distance between the motor and machine is limited, a short, wide, endless belt, with a separate idler is generally used, the function of the idler being to guide the belt in such a manner as to increase the arc of contact on the motor pulley, and also afford a means for adjusting the tension of the belt.

Some engineers claim that this form of drive possesses a desirable advantage as it affords a flexible connection between the motor and the machine, which protects the motor from serious overload, and should a strain become apparent, slippage will occur between the belt and motor pulley, preventing a disastrous overload being thrown on the motor.

The belt transmission equipment consists of a belted type motor, having an extended shaft upon which is secured the pulley. The motor is mounted on a substantial cast-iron base plate which also contains an out-board self-oiling bearing for supporting the extended shaft of the motor. A specially constructed top or bottom idler is also supported on this baseplate, the use of which enables the belt to be guided at any desired angle, thereby increasing the arc of contact of the leather belt on the motor pulley, and also permitting the tension of the belt to be adjusted as desired.

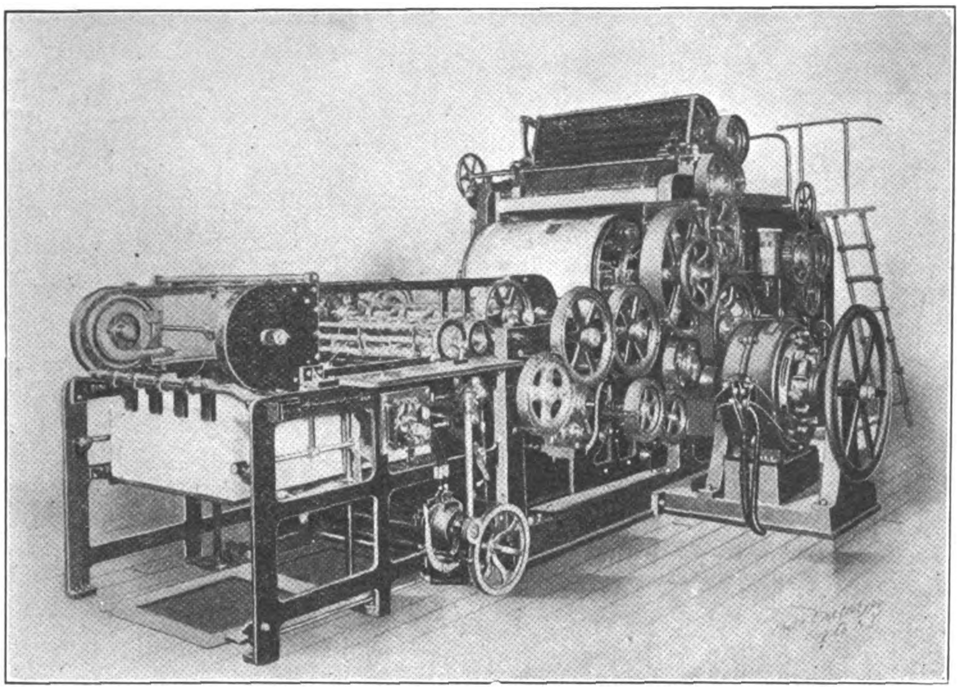


Fig. 2.—Direct-Connected Sprague Motor Driving a Cottrell Four-Color Rotary Press.

The chain drive is somewhat similar to that of the belted drive, except that instead of the usual pulleys and leather belt used for connection between the motor and the machine, a sprocket or gear wheel is applied to the main driving shaft of the machine, as well as to the motor shaft, and a special metallic endless chain is used for connection between the two sprockets. This form of drive is practically the same as a geared connection, except that its operation is noiseless, and it is possible to place the motor in close proximity to the main driving shaft of the machine owing to the short distance required between the motor and the machine shafts.

The gear drive, which is preferred by some, consists of placing a gear wheel on the main driving shaft of the machine and a pinion on the motor shaft. The motor is mounted upon rigid supporting brackets in a convenient position on the machine, so that the pinion on the motor will mesh into the gear wheel on the main driving shaft of the machine.

The gear wheels are constructed of either cast-iron or steel, and the pinions of the same material, or of raw-hide. When the raw-hide pinions are used the noise is materially reduced. A metallic casing or gear guard is used for entirely inclosing both gear and pinion, which not only reduces the noise, but also affords protection to the gear wheels. This form of drive affords a positive connection between the motor and the machine, and also enables the motor to be located in close proximity to the main driving shaft.

It is held by some engineers that direct-connected outfits usually require the use of abnormally slow-speed motors, as it is necessary to operate the motor at the same speed as the main driving shaft of the machine to which it is attached. With this form of drive the armature is connected direct to the main driving shaft of the machine. The field frame of the motor is rigidly attached to the machine by substantial iron supporting brackets. Owing to the low speed at which motors of this type are operated, the frame is necessarily larger than that employed for other forms of drive, so that while this method of application eliminates the use of any intermediate mechanism, and thereby gives a high efficiency, the first cost is greater and its use is therefore limited to applications where belts or gears would be objectionable. It may be stated that the general arrangement of the friction drive consists of a flexible mounting of a round type motor with a special friction pulley on the shaft. The motor is placed in a convenient position so that the friction pulley comes in contact with the periphery of the fly-wheel or pulley on the machine and the special mounting of the motor is such as to obtain the proper tension between the pulleys for transmitting the required power. The friction pulley is constructed of leather disks compressed on a metallic bushing between end shrouds, the periphery of which is leather. This form of drive is restricted to machines in size of about 2 hp. or less, and adapts itself to individual motor-driven machines, such as job presses, stitchers and cutters.

It may be noted that this equipment takes up a minimum amount of space, is absolutely noiseless in operation and affords a flexible connection between the motor and the machine.

◆

A TRACTION MOTOR FOR CONTINUOUS AND ALTERNATING CURRENT.

In a recent issue the "Elektrotechnische Zeitschrift" described a car supplied by the Allgemeine Elektricitats Gesellschaft for the Niederschoneweide Ostend (Copenick) tramways. This car is equipped with motors of the Winter-Eichberg type, which can be driven either by continuous or alternating current. For compact systems of town tramways continuous current working has been found best adapted, but where outlying branches or connecting links are concerned the advantages offered by alternating current becomes apparent, enabling, as it does, economies to be effected in the initial outlay and a reduction of the transformer losses. By working such branches or connecting links with alternating current it is possible to convey high tension current to the feeding points, and there transform it down by means of static transformers to the pressure required for the motors. These transformers need no attendance and have a considerably higher efficiency than converter stations, or it is possible to convey the high tension alternating current to transformers attached to the cars themselves.

On the tramway system in question continuous current was originally the only supply available, so that a transformer substation had to be provided. The line is usually worked with continuous current throughout its length, but to enable the experimental car to be driven also with alternating current, a small transformer station equipped with a motor-generator has been erected in a central position. The motor is supplied with current from the westerly portion of the overhead trolley wire and drives an alternator which furnishes single-phase alternating current through transformers to the easterly half of the trolley line. The two halves of this line are divided by a short section of dead conductor. By regulating the speed of the motor-generator the frequency of the alternating current can be varied between 25 and 40 periods at from 400 to 640 volts pressure. The pressure of the continuous current supply ranges from 500 to 550 volts. This experimental installation covers all the conditions which would obtain in the case of an interurban and urban tramways system, the small transformer station representing the town boundary, at which point the change from continuous current to alternating current working would take place in the ordinary way. In passing this point the driver has only to shift a lever on the controller from one position to another. Should he fail to effect the change at the right moment no damage would, however, result, the car in that case simply losing most of its driving force, and thus drawing attention to the omission. The car is equipped with two motors wound for a continuous current pressure of 250 to 275 volts so that with a line pressure of 550 volts they must be run in series. Hence, for continuous current working only series connection with resistance regulation at the controller is provided. The motors differ, however, from ordinary continuous current machines in that they have laminated fields to enable them to be worked with alternating current. They are six-pole machines of the Winter-Eichberg type. The collector has six brushes of which two are exciting and four short-circuiting brushes. The diagram of the winding is shown in Fig. 1, K being the short-circuiting and B the exciter brushes respectively. The coils S in the stator are the ordinary coils of the Winter-Eichberg motor, while the coils s constitute an auxiliary winding for the purpose of continuous current working. Since the armature is provided with series drum winding, the compensating coils, s, do not require to be distributed uniformly over the whole circumference. This enables the casing to be arranged in the ordinary way for traction motors. Naturally it would be possible to dispense with the coils s by disconnecting the short-circuiting brushes when running with continuous current. But as this would introduce a further complication into the controller, Herr Eichberg preferred to compensate the action of the short-circuit current in the armature by means of the coils s. For the rest it may be observed that the turns in these coils correspond in number to those in the armature winding but they carry a smaller volume of current, since less is taken when driving with continuous current than with alternating current. The effect of the coils s may be explained with the aid of the diagram (Fig. 2) which represents a two-pole arrangement. The only field which really passes through the armature is the active magnetic field, Φ, represented in the diagram by horizontal lines. Were the coil s not provided the armature would generate a vertical field which would induce a current between K K. As in Fig. 1, K K are the short-circuiting brushes and the exciter brushes are marked E E. S is the main winding in the stator and s the compensating coil required for continuous current working. When running with alternating current the compensating coils are cut out at the controller. With continuous current, on the other hand, the brushes, E E, are connected in series with the compensating winding, it being in this way insured that the compensating field is always exactly proportional to the armature current. Commutating poles are not used, despite which fact commutation with both continuous and alternating current is as sparkless when starting and running as with an ordinary continuous current traction motor. The speed of the car is from 15 km. to 20 km. per hour when the continuous current supply is used and from 25 km. to 35 km. per hour according to the periodicity, when the motors are receiving alternating current. This is in accordance with practical requirements, since a higher rate of speed is permissible out of town. Fig. 3 is a diagram of the connections in the car. Each circuit is provided with an automatic cut-out. It is, however, intended in future cars of the type to employ only one such device to serve both for the continuous and alternating currents respectively. The controllers resemble those of standard series-parallel type. Combined with each is a two-way switch, W G, which serves to change over from one system to the other as required. The windings s are also cut in or out through this switch. The armatures remain in series at all positions of the controller, while the stators may be connected in series or parallel through the main lever. A mechanical attachment actuated through the lever of the switch W G, insures that the stators are in series when continuous current is being supplied to the motors.—"Electrical Engineer," London.

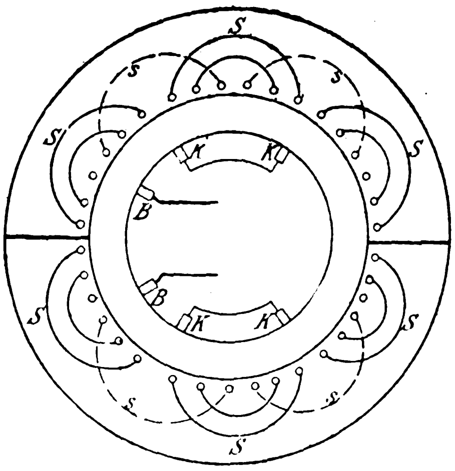


FIG. 1.

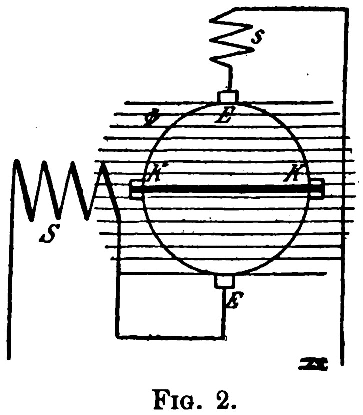


FIG. 2.

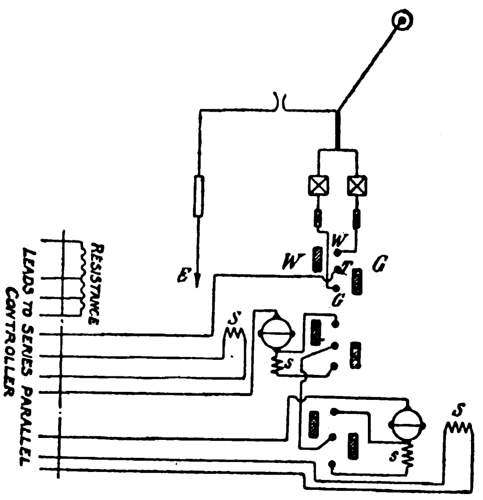


FIG. 3.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

THE INCANDESCENT LAMP.

A Standard Pressure.—The adoption of a lamp of about 110 to 117 volts pressure, and an amperage corresponding to a fixed power consumption, was due to the production of a light source about equal to the ordinary gas burner of that period. The 16 cp. lamp thus materialized with a certain resistance, amperage, voltage and life. On this score, the life of a lamp offers an interesting study in skill, in manufacture, the limitations of materials and the scientific application which led to its improvement.

Lamp life is to some extent dependent upon the pressure. A changing or variable pressure will mean an over-illumination for one period of time and a decreased amount of light on other occasions. A uniform lighting pressure is therefore one of the first means to be adopted to secure a reasonably long life to a lamp. Other reasons why the lamp deteriorates and breaks are old age, vibration, a poor vacuum or a natural though early fracture of the filament.

Watts per Candle Power.—Different makes of lamps present different commercial propositions with respect to their life and economical operation as light givers. As already stated, a lamp is a device in which electrical energy is transformed into heat and then again into light energy. Although the outlines of this idea are simple and apparent, it is difficult to construct a device in which it is economically carried out. What is regarded as economy to-day is an economy of the lowest order, for the very reason that the twofold process of turning electricity into heat and from heat into light involves an ineradicable loss. Between the first and second step the efficiency is so high that nothing can be said in criticism. Between the second and third step the loss is so great that it reduces the effectiveness of the method to a low figure in an engineering sense. Calling the electrical energy sent into the lamp 100 and the heat energy given out by the lamp 97, then the light energy given out will only equal about 3 in comparison. In other words, if the step from the heat to the light could be better bridged than by such methods as are now in vogue, 16 cp. would become about 30 times as powerful at a maximum, or any less number of times as great, according to the efficiency. A 16 cp. lamp takes about 3.5 watts per candle power or something like 56 watts in all. If the conversion of power was complete from the electricity to the light without the second step the entire consumption could not exceed 2 watts.

Candle Power per Horse Power.—Experiments, conducted by Professors Barker, Brackett, Young and Rowland and published in the "American Journal of Science" about March 27, 1880, show a rating of calorimeter and photometer test per horse power as follows: 4.8, 8.9, 5.8 and 9.2 sixteen candle power lamps of four different makes per indicated horse power. An allowance of 30 per cent. was made for heating of wires, generator losses and engine friction. In the report handed in, the following statement appears: "The increased efficiency with rise of temperature is clearly shown and there is no reason, provided the carbon filaments can be made to stand, why the number of candles per horse power might not be greatly increased." As a means of indicating the drop in resistance, the figures obtained from a lamp are presented when in use as follows:

Resistance in ohms.	Condition of filament.
123	Cold.
94	Orange light.
83.7	$\frac{9}{10}$ candle power.
79.8	5 " "
75	18 " "

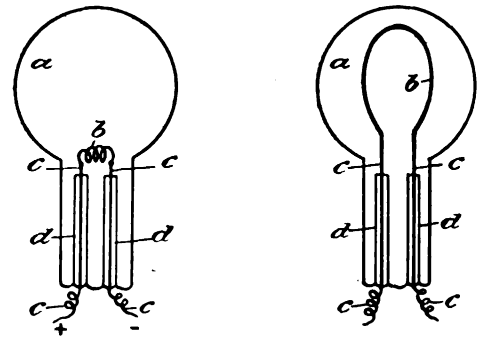
Figures based upon purchasable lamps at present can be compared with this table on the basis of the number of watt-consumed per candle power, though the resistances of each stage of light development are not given:

Watts per candle power.	16 cp. lamps per horse power.
1.0	46
1.5	31
2.0	23
2.5	18
3.0	15
3.5	13

The correct conclusion to be drawn from this array of facts, is not that power is being deliberately wasted in producing light, but that if more than the customary amount is produced it is so done at the risk of the life of the filament. In other words, the filament must be supplied with a perfectly uniform pressure to last, even under ordinary conditions, through its proper period. If the filament is forced, as indicated by the decrease in watts per candle power in the table, the increase in light is obtained by a nearer approach to the critical danger point, the point at which the carbon will fracture with greater ease, due to the abnormal temperature at which it is run. No guarantees of life are given by manufacturers unless the conditions stipulated at purchase are observed.

Higher candle powers per unit of energy cannot be economically obtained by means of carbon, but the substitution for this of a rare oxide filament, such as one made of thorium, etc., means the successful and long-continued operation of a 1.5 watt per candle power lamp, even with variations in line pressure.

Making the Lamp.—Sir William Crookes invented a radiometer consisting of a glass bulb with leading-in wires, an account of which was published in the Philosophical Transactions of the Royal Society of London about the time that lamp making only existed as an experiment. In this piece of physical apparatus leading-in wires of platinum were employed and a vacuum used to develop the maximum effect with the illuminating element. The incandescent lamp differs only from this in the use of a carbon horseshoe or high resistance arch joining the platinum terminals, as shown in the illustration.



CROOKES' RADIOMETER.

MODERN INCANDESCENT LAMP.

In both figures, *a* is the exhausted glass chamber, *b* is the illuminant or incandescing conductor, *c c* are the leading-in wires of platinum, to which the ends of the illuminant are attached, and which are hermetically sealed by fusion into glass tubes *d d*. The main conducting wires are attached at + and —.

The exact words of the patent granted to Edison on January 27, 1880, read as follows: "An electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistances made as described and secured to metallic wires as set forth.

"The combination of carbon filaments with a receiver made entirely of glass, and conductors passing through the glass, and from which receiver the air is exhausted for the purpose set forth."

The lamps invented by Edward Weston, Hiram Maxim and Moses G. Farmer were types of great advancement. They ultimately became the property of the concern then called the United States Electric Lighting Company. The introduction of the hydro-carbon method by Maxim was one of the most important inventions in lamp construction and is to-day an indispensable element of success.

Siemens & Halske of Germany made an exhaustive series of tests for the purpose of determining the relative merits of the treated and untreated carbon filaments with respect to the hydro-carbon process. Their results are tabulated as follows:

Lamps with Untreated Carbons.

Burning hours.	EMF. in volts.	Current in amperes.	C. P.	C.P. per HP.	Watts per C.P.
0	100	.687	24.25	259	2.8
100	"	.666	15.7	173	4.2
200	"	.666	15.3	169	5.0
300	"	·664	15.2	167	4.4
400	"	·653	14 7	165	4 5
500	"	.640	13.7	157	4·7
600	"	.634	13.3	154	4 8
700	"	.630	13.1	153	4.9
800	"	.620	12.5	148	5.0

The results with treated carbons are doubly interesting when the column indicating the watts per candle are examined, particularly in connection with the number of hours of burning:

Lamps with Treated Carbons.

Burning hours.	EMF. in olts.	Current in amperes.	C. P.	C.P. per HP.	Watts per CP.
0	100	.552	25.0	333	2·2
100	"	.550	22.5	300	2·4
200	"	.550	22.0	290	2·5
300	"	.548	21.0	282	2·6
400	"	·547	20.0	270	2·7
500	"	.545	18·6	251	2·9
600	"	.545	17·1	231	3·2
700	"	.540	16.0	218	3·4
800	"	.532	15.3	210	3·4

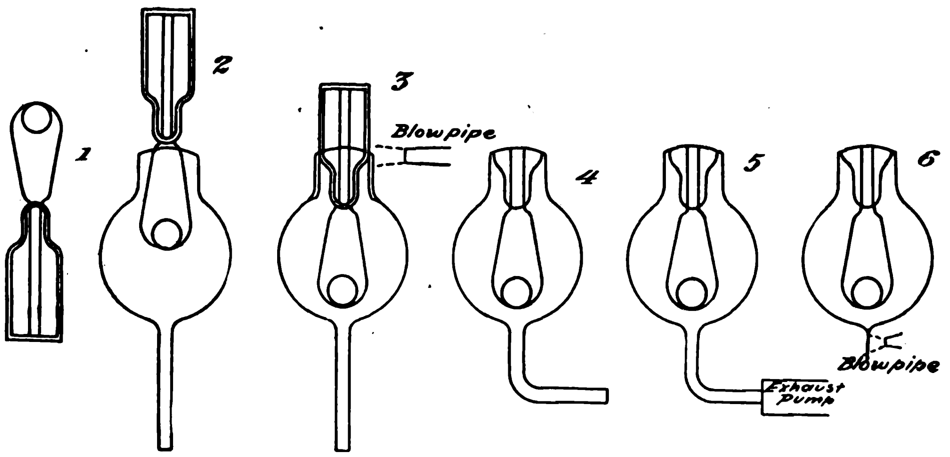
Summing up the results, the following data is of interest with respect to these figures:

	Untreated carbons.	Treated carbons.
Decrease in efficiency (per cent.).........	36.9	57.10
Decrease in illumination (per cent.)....	38.8	51.50
Average illumination cp. per lamp.......	19.67	14.91
Average output in cp. per hp.........	264.1	167.70
Increase in resistance in per cent........	3.8	10.80

The increase of over 30 per cent. in light due to the hydro-carbon treatment establishes the immense value of this process in the commercial manufacture and use of lamps.

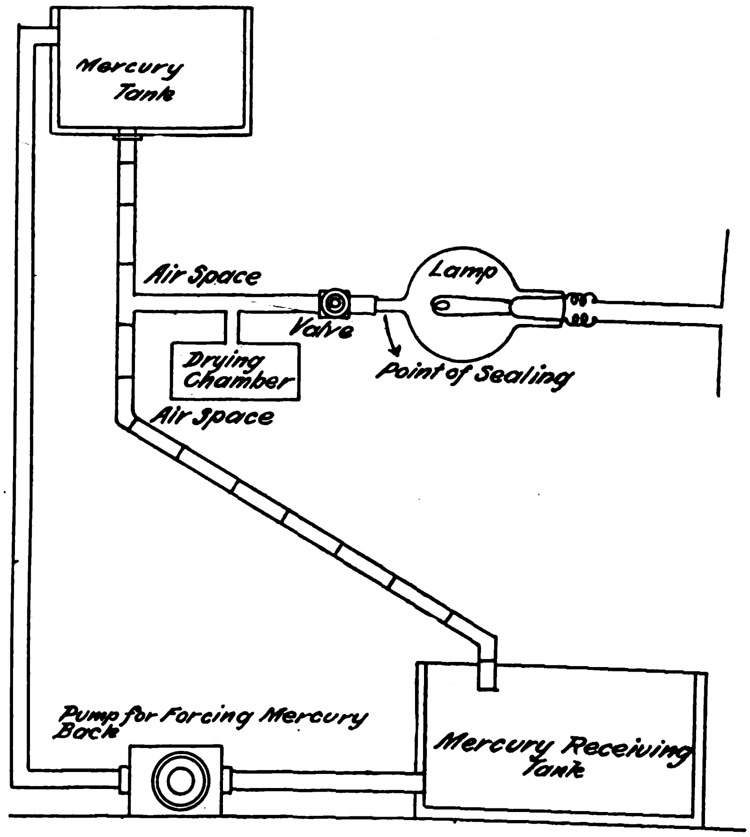
The manufacture of the lamp bulb, with its stem and tube for exhaustion, is shown in its successive stages in the figures 1, 2, 3, 4, 5 and 6.

The blowing of the bulb and the attachment of the stem with its platinum terminals and carbon filament constitute one-half of the process. The rest of the operation consists of the elimination of the air and the final sealing up of the tip of the lamp. A metal base is finally attached and the leading-in wires soldered to it. Plaster of paris is used to give firmness to the combination and solidity to the base. In the United States, the screw base is almost entirely employed and lamp sockets are made correspondingly.



Process of Lamp Manufacture.

The Vacuum Process.—Pumps for the purpose of creating a good vacuum have reached a comparatively high stage of development. They are constructed on the general principle of the Torrecellian method of producing exhaustion by means of mercury in a glass tube. If a tube sealed at one end and about 40 inches in length, is filled with mercury, and then its open end is carefully inserted in a deep vessel containing the metal, the mercury will fall away from the upper sealed end to some extent. In this empty space is found what was originally called a Torrecellian vacuum, a vacuum of a very high degree of exhaustion with respect to the atmosphere as it is.



Method of Exhausting Lamp by Mercury Pump.

The pumps employed are of a type in which a falling column of mercury produces a vacuum in the lamp by dropping down a tube to which the lamp is attached. The junction is effected on the side between lamp and exhaust pump. Globules or spaces form between the various sections of the mercury column. A systematic process of rarefaction goes on until the exhaustion reaches a safe point. This is about one one-millionth of an atmosphere, that is to say, one one-millionth of the pressure of the air, which is generally recorded as being about 15 pounds to the square inch. A sketch of this pump with regard to the principle it involves is shown in the illustration.

During the process of exhaustion the lamp has a weak current sent through it only sufficient to heat the carbon and the surrounding air. As the rarefaction increases the current is increased, until at the end of the process the lamp burns with full candle power.

Value of a Vacuum.—The absence of air around the filament means less immediate radiation from the incandescent mass to the outside air. The value of this is found in the lower current value required to heat the filament to incandesence. The lower the current value the higher the efficiency, other things being equal. By means of a vacuum a degree of commercial economy is obtained which lifts the incandescent lamp, light for light, to a much higher plane than gas. The relative efficiencies may be noted in the following general manner as about 10 per cent. for the arc, 3 per cent. for the incandescent and 1 or 1.5 per cent. for gas. Using a neutral gas in the bulb would mean a subtraction of heat from the filament to the outside air. This is not an efficient method, and for that reason has been practically discontinued. The advantage of heating the filament to get rid of foreign gases occluded by it during exhaustion is obvious. After the process is complete, the glass tip, connecting it by an orifice to the exhaust tube is melted and sealed permanently. In actual practice a long string of lamps are treated in this manner, the exhaustion and final sealing forming part of a rapid process.

Absorbtion of Moisture.—The prevalence of moisture is one of the bugbears in the way of obtaining a complete vacuum. In order to make this difficulty as negligible a feature as possible, the moisture is largely removed by means of a small drying tank attached to the pump. This little vessel contains a vapor-absorbing mixture, such as sulphuric or phosphoric acid, called the drying solution. A little phosphorus may also be introduced into a tube connected to the lamp for the purpose of combining with the last traces of oxygen present. In the Geissler air pump the mercury, instead of being pumped above after use is automatically lifted. The advantage of this is the same as using some pressure method without the risk of getting air into the mercury. The lifting of it permits it to operate as in the first place, to produce a vacuum by the Torrecellian principle. Lamps using no vacuum have come into the lighting field, but in this case the material giving incandescence is of an inoxidizable substance. Such lamps require certain preliminaries to be gone through before they will give illumination.

ECONOMY IN BOILER PLANT.

Although builders of boilers are presumably the persons most interested in building an efficient steam-raising plant, it must be remembered that they are hampered by conditions of competition arising from an improper understanding of the process of combustion and heat transmission on the part of prospective purchasers. The paper recently read before the Institution of Electrical Engineers in England by Messrs. Booth and Kershaw pointed out that, for the proper combustion of bituminous coal, a large combustion chamber and the use of refractory surfaces is necessary. This, however, means increased cost of boiler setting, and the temptation is very strong to tender for and build a boiler which will generate its guaranteed steam per pound of coal, when, say, anthracite is used, independently of the consideration as to whether Welsh coal can be economically brought to the locality of the boiler. In asking for tenders for boilers, therefore, the class of fuel to be used should be specified and a water evaporation guarantee on this basis asked for.

Where such precautions are previously omitted, losses in the steam-raising plant are certain to ensue. Air will probably be admitted in excess above the grate to avoid smoke nuisance, bringing down the temperature of the furnace gases. Increasing the amount of air admitted increases the energy consumed in producing draught and the amount of heat carried off to the stack. An artifice to prevent the premature cooling of the gases by contact with water-cooled plates and tubes is the introduction into the furnace of refractory brick baffles. Where the combustion chamber is not sufficiently large to contain these refractory surfaces, they are often interspersed among the tubes and flues. As, however, the gases have already become partially cooled, such devices can only be regarded as makeshifts to cover an initially bad design, and have, moreover, the effect of reducing the effective draught. Where it is found absolutely necessary for the avoidance of smoke nuisance to admit air above the grate, such air should be previously heated as much as possible to reduce the cooling of the combustion chamber as far as practicable.

In some boilers steam is admitted below the fire-grate. This device is useful where fuel giving intense local heat, such as anthracite or coke is used, as the rapid deterioration of the furnace bars is avoided by the cooling action of the steam, and this steam, in passing through the bed of incandescent fuel, unites with the carbon to produce water-gas It is, however, a fallacy to suppose that the admission of steam above the grate aids combustion. The space above the fires should be exclusively reserved for the proper intermixing and ignition of air, oxygen, carbon or carbon monoxide, and the energy absorbed in the dissociation of water will result in a net loss of heat.

To obtain the greatest amount of steam per pound of coal from the boiler, the maximum difference of temperature between the water and flue gases must be obtained at every point along the passage of the gases through the boiler. For this reason the hottest water should be found at the point where the gases first impinge on the heating surfaces, and the point of inlet of the feed water should be as near as possible to the point of exit of the gases to the main flue. Due recognition of the elementary principle that cold water is of higher specific gravity than hot will tend to better design from the point of view of circulation, and consequently better evaporating qualities.

WRINKLES.*

EDITED BY H. C. ABELL.

Removing Crank Pins.

Some time ago we were obliged to take out and replace a crank pin on a 250 hp. engine. The pin was shrunk in and penned over, as is the custom, but had become a little loose; still we could not force it out.

We drilled a hole through the center of the pin from end to end, tapped each end to fit a three-quarter inch pipe thread, and screwed a piece of pipe in the same with the cold-water hose attached to one end of the pipe. After heating the crank and pin to a cherry red by the use of the portable forge we turned on the water, cooling the pin, which shrunk enough so it could be pulled out by the attached pipe.

C. E. Inman, Warren, O.

Silent Chain-Drive to Replace Governor Belt.

Since it is the duty of a governor on an engine to adjust the supply of steam admitted to the cylinder to suit the load, the medium of transmission of power to drive the governor must act as quickly as possible. It is the duty of the flywheel to take care of the variations of the load instantaneously, while governor adjusts same by controlling the steam—taking a comparatively longer period of time to do so. We also know that under best conditions possible there is belt slippage and furthermore that a belt may break without giving any warning.

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*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

To overcome these deficiencies we have replaced the governor belt on three engines by a silent chain-drive, and we are well pleased with the change. To do this a special sprocket wheel had to be made to fit over the engine shaft; a sprocket is also made to replace the governor pulley.

The silent chain-drive has four advantages over the belt, in that it cannot slip, it does not stretch, oil does not ruin it, and it is stronger.

G. H. Cushman, San Antonio, Tex.

Curing an Engine that Took Water Frequently.

An engine taking steam from the extreme end of a long line of piping was troubled frequently with water; taking the cap off the end of the steam line and putting on a drop elbow, with a drip from the bottom of it leading to the drip system, cured it.

H. C. Hall,
Fall River, Mass.

Detecting Leak in Receiver.

A receiver drip on a vertical tandem compound-condensing engine was found hot after the engine had been shut down several hours; throttle valve was found to be tight, so the only place left to look was the reheating coil in the receiver. To take head off the receiver was a long, awkward and tedious job, so to find whether the leak was large or small all drips were closed, also valve between engine and condenser, and by noting pressure on receiver gauge the desired information was soon obtained.

H. C. Hall, Fall River, Mass.

Method of Testing a Large Gas Engine Without a Brake.

It was necessary to test a large producer-gas engine, driving a 700 kw., 13,200-volt generator. The only available electric load was too variable to be of any use, so the following arrangement was adopted:

A triangular float, supported by oil barrels at the corners, was constructed with out-riggers supporting high-tension insulators. The three-phase line was led to an upright in the middle of the float and thence one leg to each out-rigger. A short bar of No. 00 bare copper was used as a terminal dipping into the river.

With about ½ inch of the terminals submerged at 20 feet distance, full voltage, full load was obtained.

A comparatively slight variation of generator voltage would vary the load from one-quarter to full, and the same could be held absolutely steady at any point. A perfect load and regulation test was obtained on the engine.

It was observed that nearly all the resistance was at the contacts, the distance apart of the electrodes having no effect from 6 to 20 feet.

At heavy load the electrodes made no contact with the water but were surrounded by a ball of incandescent gas, approximately 2½ inches in diameter, which formed the conducting medium.

M. A. Maxwell.

A NEW TYPE OF SINGLE-PHASE ALTERNATING CURRENT MOTOR FOR ELEVATOR WORK.*

BY G. PERCY COLE.

The employment of electric motors for elevator service has been very general during the last few years, mainly for the following reasons:

There is a considerable saving in the cost of installation of an electric over a hydraulic elevator, since the latter requires pumps and tanks in addition to the elevator mechanism.

The electric elevator requires very little space compared with a hydraulic machine, since the whole mechanism—motor elevator and drum—can be installed at the top of the elevator shaft. A space 6 feet square is usually sufficient.

Operating expenses are not so high, since the simplicity of operation of the electric elevator does not require the attendance of an engineer.

The simplicity of electric-power distribution over hydraulic distribution greatly aids the solution of the problem of control. The electric elevator can be operated by rope or push-button control; the employment of an expert operator is therefore not required. In fact, with this latter method, no operator is needed, since push buttons operating an auxiliary controlling system, which in turn operates the regular controller of the motor, can be placed on each floor.

The large amount of space required by the hydraulic elevator often necessitates the mechanism being placed in an exposed position, thus endangering it by freezing. With the electric motor there is no danger of its freezing up.

The operating expense of an electric elevator as compared with other types is considerably smaller, with the exception, perhaps, of a hydraulic elevator supplied from a central station accumulator, for in the business centers of many of our largest cities a number of hydraulic elevators can be supplied from a central station at a very reasonable figure.

For the foregoing and also many other reasons, the electric type of elevator has found great favor.

The majority of electric elevators now in operation in America employ direct current motors, the usual pressure of supply in the business centers being 220 volts, and in the outlying districts, 500 volts. Polyphase motors, fitted with slip rings and resistances for variable-speed work, are used to a small extent in this country for operating elevators, but their operation cannot be considered to be at all satisfactory. This is chiefly due to the very great disturbing effect on the line that is inherent to the polyphase induction motor when thrown on the full line voltage. Being essentially a constant speed motor, so unsuited is the polyphase induction motor to the heavy requirements of elevator service that it is extremely unlikely that engineers will try to develop it further in this direction. Elevator service demands a fair amount of torque with reasonable starting currents, and the polyphase induction motor alongside of the continuous current motor, in these respects makes a very poor showing indeed.

In New York City the proportion of direct current motors to polyphase induction motors operating elavators is in the ratio of 10 to 1, the polyphase motors being employed chiefly in those sections of the city where it is at present impossible to obtain a direct current supply, and the constructors of elevators have had no alternative but to employ polyphase induction motors.

In many of our largest cities we now find the power companies changing over whole sections from direct to alternating current supply. In fact, in many cities we already find large areas where direct current cannot be had at any price. If, therefore, the electric elevator is to retain its hold, it is imperative that we have a first-class and thoroughly reliable alternating current motor. As either polyphase or single-phase currents are frequently available, the central station could often connect their type of motor. But as elevator service usually calls for motors of relatively small individual capacity, there are many reasons why service can be given to better advantage single-phase than polyphase. This fact has been recognized by central stations and also by manufacturing companies, and for a good many years a most energetic effort has been made to develop a form of single-phase motor construction suitable for this work. Such a motor, to be entirely satisfactory, should possess the starting characteristics of the direct current series motor and the running characteristics of the direct current shunt motor. Designers have struggled in vain with this problem until quite recently. A type of motor is now available, however, which affords practically all of the desirable characteristics of the direct current elevator motor, and it is this motor which the writer desires to briefly describe.

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*Abstract of paper read before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11, 1905.

This motor is the invention of Mr. Leo Schuler, an electrical engineer of Frankfort, Germany. In construction it is a combination of the repulsion and induction forms of single-phase motors. Mechanically, the motor consists of an ordinary induction motor frame. It has an ordinary induction motor stator core, built up of laminated sheet steel. The stator winding consists of form-wound coils, distributed in slots around the inner periphery of the stator core. The motor is built up of laminated steel in the same way as the stator, and carries a progressive wave winding similar to the usual direct current armature; on one side is provided a commutator, and on the other side three collector rings connected into the winding in polyphase relation.

In operation, the first effort of rotation is secured with connections corresponding to the well-known repulsion motor. After the armature has attained about one-quarter speed the polyphase resistance, connected to the armature through the slip rings, is thrown in and gradually short-circuited as the armature runs up to full speed. The brushes bearing on the commutator in the usual elevator equipment are not completely short-circuited, but have a fixed resistance interposed between them; at no time are the brushes removed from the commutator.

As you are all aware, the repulsion type of motor has starting characteristics very similar to those of a direct current series motor; that is, a very heavy torque is secured at the first instant of starting. This torque decreases rapidly as the speed increases. Correspondingly the current taken by the stator winding from the outside supply circuit also decreases rapidly, and this is also the case with the current through the repulsion brush circuit. On the other hand, in a single-phase induction motor the torque on the rotor at rest is zero, but increases gradually to a maximum as the speed increases toward full speed. By making use of a combination of these torques, the inventor of this motor has developed a machine that has exactly the torque characteristics necessary for elevator and hoist service, and has substantially combined in a single machine two heretofore well-known forms of single-phase motors. Torque at any speed, it will be seen, is approximately equal to the sum of the torques due to the repulsion effort on the commutator end of the motor and to the induction motor effort on the slip ring end of the motor.

Elevator service usually requires from 40 to 50 per cent. of full-load torque at the first instant of starting, and the most satisfactory types of direct current elevator motors provide this torque with a first rush of current not to exceed 50 per cent. in excess of the full-load running current. In other words, a good motor for electric elevator work should develop the same torque per ampere of starting current as is developed per ampere of running current. The single-phase motor described in this paper is capable of a development of such a starting efficiency; in fact, by a suitable arrangement of starting resistance it is quite possible to secure a starting torque per ampere appreciably in excess of the running torque per ampere. One of the novel features of this motor is that it is capable of speed control for quite a percentage of its speed range by regulation of the polyphase resistance. It has been experimentally found that successful regulation, down to as low as half-speed, can be secured without trouble—the motor acting electrically as would a series direct-current motor under armature resistance control.

This motor may properly be called a repulsion induction motor since it starts as a repulsion motor, and runs practically entirely as a single-phase induction motor.

An outfit consisting of one of these new single-phase elevator motors direct coupled to an elevator mechanism fitted with rope control has been in practical service over a period of five or six months, and has operated with extremely satisfactory results. Electric control mechanism has not as yet been developed by the manufacturers, but these features will be brought out as adaptation of the motor to prevailing forms of standard elevator construction is effected in cooperation with the various prominent elevator manufacturers of the country.

There has been considerable inquiry as to the amount of sparking developed on the commutator of these equipments. The writer may say that the sparking is practically nil. The life of the commutator is predicted to be equal to that of best direct current elevator motors.

Among the more conspicuous advantages of this motor over other types used for elevater work may be enumerated the following:

1. In this type of motor it is not the line current but simply the induced armature current that is being commutated. This allows of the primary stator winding being wound, say, for any convenient pressure up to 1,000 volts.

2. Control can be from a distance since only a throw-over switch is required to reverse the motor.

3. Being a single-phase motor, the simplicity and lessened first cost of the supply circuit distribution bear very largely on the cost of the installation.

4. The commutator can be kept very small since it is only traversed by a large amount of current during the starting period, and when under full speed takes practically no current.

5. Since the load is not applied abruptly to the circuit, but gradually, this elevator motor may have its supply circuit attached to the same transformer carrying lights without affecting the lights.

6. The power factor of the motor is quite high, being about 80 to 85 per cent. both in starting and running speed. It is worthy of note that in polyphase induction motors used for this same service, although a high-power factor is shown at starting the average running power factor is only 36 per cent., showing that the polyphase motor when used for elevator service was much larger than the average conditions would call for, but it is necessary to provide this capacity in order to accommodate any heavy loads that must occasionally be carried, and to provide sufficient static torque. The high-power factor at starting of the polyphase motor is simply due to the enormous copper loss due to the heavy starting currents.

7. This motor is capable of standing heavy overloads. It will develop from 50 to 60 per cent. overload for short intervals without injury to the windings.

8. Low starting current, which is inherent in this type of motor, makes it possible to operate it from one leg of a two or three-phase circuit without unbalancing the circuits.

In conclusion, I may state that we be-believe we have in this motor one that is in every respect the equal, and in many ways the superior, of the best type of direct current elevator motor. Its characteristics are such that the acceleration can be made anything desired. The field that it will occupy is indeed very broad. The need of a practical, variable speed, alternating current motor has long been felt and it is my belief that the motor described will supply that want.

Electrical Resistance.

At the annual meeting of the North of England Institute of Mining and Mechanical Engineers, recently held at Newcastle, a paper by Mr. G. C. Wood was presented giving the results of a year's work in determining the specific electrical resistance of coal and various ores. The electrical resistance of coal was found to be so high that it may be considered to be a very fair insulator, a fact of practical value in connection with electrical work underground.

It was remarked in discussion that coal had a much higher resistance than Barton ballast, which had lately been discovered by the North-Eastern Railway to be particularly effective in preventing the return of the electric current to earth.

International Street Railway Convention.

During the week beginning September 25, Philadelphia will be the center of attraction for electric railway men and all those who make supplies for such lines. The occasion will be the annual convention of the International Street Railway Association.

About 800 delegates and others are expected to be present. E. M. Brady of New York is president of the association, and T. C. Pennington of Chicago is secretary. Headquarters will be in the Bellevue-Stratford, and the business meetings will be held in the ball-room and the Clover Club room.

This association consists of officers of electric railways all over the United States. Equipment and electric supply companies are also members. The purpose is to bring the various interests together for an exchange of views and to discuss practical methods of improving electric railways and the service they give.

In connection with the convention there will be an exhibition of electric appliances, street railway cars, etc. This will be at the Commercial Museums, where space has been arranged for.

Proposals Invited.

The Navy Department at Washington, D. C., through the Bureau of Supplies and Accounts, is inviting sealed proposals until September 5 for furnishing the Boston, New York, League Island and other Eastern Navy Yards with the following electrical material: Schedule 82, arc lamps, lamp cord, wire; schedule 83, motor; electrical supplies, electric smoothing irons; schedule 84, starting rheostats; schedule 86, electrical equipments for rammers, etc.; schedule 89, Okonite tape. On August 29 the Bureau will open bids for furnishing Eastern Navy Yards with the following: Schedule 71, telephone cable; schedule 73, battery cells, cable; schedule 75, electric glue heaters. On September 19 the Bureau will open bids for furnishing Western Navy Yards with the following: Schedule 77, motors; schedule 78, circuit breakers, electric wire, ammeters, resistance ribbon; schedule 79, motors. Specifications and blank proposals for all the above supplies may be obtained on application to the Bureau. Applicants should designate by number the schedule desired. Those for Eastern yards may also be secured at the Navy Pay Office in New York.

To Manufacturers and Exporters.

The Department of Commerce and Labor at Washington, is desirous of securing the co-operation of manufacturers and other persons interested in the efforts being made by that Department through the Bureau of Manufactures, to extend the foreign trade of the United States.

In furtherance of this work, it is proposed to establish a comprehensive card index which will enable the Department, upon application, to furnish information desired by manufacturers, or by intending purchasers, and it is contemplated to extend the system, if the necessary authority shall be granted by Congress, to the principal consulates.

To enable the Bureau to prepare such an index manufacturers and exporters are requested to furnish briefly any information which they may desire to have recorded in connection with their business. The Department will, upon request, furnish a blank form for filling in.

A Tenth Anniversary Celebrated.

The Pawtucket Association of Stationary Engineers of Pawtucket, R. I., one of the most progressive and energetic bodies where education in the science and art of steam engineering is its principal motto, celebrated its tenth anniversary on August 20. A genuine Rhode Island shore dinner was served in the Palace Gardens on the west shore of Narragansett Bay and everyone thoroughly enjoyed himself.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 15, 1905.

Electric Railways and Appliances.

797,141. Block-Signal System for Electric Railways. Frank R. McBerty, Evanston, and Malcolm E. Launbranch, Chicago, Ill., assignors to the Western Electric Company. Filed Sept. 9, 1904.

797,180. Electrical Safety Apparatus for Signaling on Railways. Henri Coulin, Paris, France, assignor to the Societe Cousin & Co., same place. Filed April 3, 1905.

797,229. Car-Fender. William B. Rohmer, Bay St. Louis, Miss. Filed Nov. 7, 1904.

797,252. Electric Switch. Milan V. Ayres, Newton, and Daniel E. Hennessy, Everett, Mass. Filed Feb. 9, 1905.

797,254. Means for Transmitting Electricity to Vehicles on Electric Railways. Attilio Beer, Venice, Italy. Filed Aug. 18, 1902.

797,342. Trolley-Wheel. Frank E. Bryan, Niles, O. Filed Dec. 24, 1904.

797,355. Trolley-Mounting. George E. Henry, Vincennes, Ind. Filed Nov. 9, 1904.

797,394. Third-Rail Guard. Melchior Zugermayer, East Rutherford, N. J. Filed April 19, 1905.

797,490. Insulated Railway-Rail Joint. Bancroft G. Braine, Brooklyn, N. Y., assignor to the Continuous Rail Joint Company of America. Filed July 23, 1902.

Electric Lights and Appliances.

797,090. Lamp-Socket. William Uschmann, Schenectady, N. Y. Filed June 1, 1904.

797,250. Guard for Incandescent Electric Lamps. Charles P. Anderson, St. Louis, Mo. Filed March 17, 1905.

Electrical Machinery and Apparatus.

797,015. Induction-Arrester. Edward C. Paramor Philadelphia, Pa. Filed Dec. 1, 1904.

797,048. Circuit-Breaker. Harry P. Davis, Pittsburg and Arthur B. Reynders, Wilkinsburg, Pa., assignors to the Westinghouse Electric & Manufacturing Company. Filed Feb. 27, 1904.

797,049. Electrical Terminal Connection. Isaac De Kaiser, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company, File Nov. 21, 1903.

797,050. Insulator. William W. Dunsmore, Falconer N. Y. Filed Aug. 24, 1904.

797,065. Electric Switch. Benjamin S. Luther, Boston Mass., assignor to the Chase-Shawmut Company Newburyport, Mass. Filed April 4, 1904.

797,060-061. Controller for Alternating-Current Apparatus and Electric Motors. Ray P. Jackson, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed June 6, 1904 and Jan. 23, 1905.

797,198. Automatic Electric Cut-Off. Roy M. Griffith Elwood, Ind. Filed Jan. 16, 1905.

797,215. Plug-Box for Electric Circuits. Henry G. Osborne and Edward Richter, New York City. Filed May 23, 1904.

797,217. Operating Mechanism for Controllers. William D. Pomeroy, Norwood, O., assignor, by mesne assignments, to the Bullock Electric Company. Filed Dec. 8, 1903.

797,271. Electric Switch. Gano S. Dunn, East Orange, N. J., assignor to the Crocker-Wheeler Company, Ampere, N. J. Filed Aug. 25, 1903.

797,396. Electric Motor. Ralph E. Barker, Lynn, Mass., assignor to the General Electric Company. Filed Oct. 26, 1903.

797,433. Electric Switch. Edward M. Hewlett Schenectady, N. Y., assignor to the General Electric Company. Filed Nov. 4, 1904.

797,498. Block Signal System. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Filed Jan. 21, 1905.

797,517. Measuring Instrument. John H. Kimball Lynn, Mass., assignor to the General Electric Company. Filed Aug. 25, 1904.

797,518. System of Electrical Distribution. Sigvald Krohn, Berlin, Germany. Filed Nov. 2, 1899.

797,526. Switch. Frank R. McBerty, Evanston, Ill. assignor to the Western Electric Company, Chicago, Ill. Filed Dec. 21, 1903.

Miscellaneous.

797,110. Storage Battery. Gustave K. Hartung, New York, City. Filed April 30, 1904.

797,424. Electric Fire-Alarm Apparatus. Eugene Fuller, Arctic Center, R. I. Filed Jan. 28, 1905.

797,544. Space Telegraphy. Ferdinand Braun, Strassburg, Germany. Original application filed Feb. 6, 1899. Divided and this application filed May 13 1903.

THE TELEPHONE WORLD.

Telephone Company Purchased.

All the property of the Standard Telephone & Telegraph Company was sold about 10 days ago by order of the court by the Bucks County Trust Company, trustees under the mortgage, to Reynolds D. Brown, of Philadelphia, Pa., for $50,000. After the sale Mr. Brown refused to give any information regarding whom he represented. It was reported that he acted for the Keystone Telephone Company.

The purchase price, bondholders said, is about 25 per cent. of the cost of the system. Among the bidders were several Lancaster financiers and Treasurer Elkins, of the Colonial Trust Company, Philadelphia, who represented the bondholders' committee. It was said that representatives of the Bell Company were present, but offered no bids.

This company, which went into the hands of a receiver a few months ago, has been operating less than four years. On account of competition and low rates, the company was not able to meet its current operating expenses or to lay aside a fund to offset depreciation of its plant.

Chicago to Use Its Own Telephones.

The Chicago Telephone Company will no longer receive $2,131 a year rental for the instruments which it supplies for Chicago's police and fire telephone system. That city intends to use its own apparatus. City Electrician Carroll had a conference with Mayor Dunne and advocated city ownership of the instruments. The contract with the telephone company is a verbal one, and Mr. Carroll will at once notify the company that it will be terminated as soon as the city can install its own apparatus, which it is estimated will cost $7,000.

Flemington, N. J., has a telephone war. A few days ago the Pennsylvania Telephone Company sent men to remove the wires of other companies, excepting those of the Lebanon Telephone Company and the fire alarm system, from its poles. The men soon had many wires down, badly crippling the telephone service in Flemington, and depriving some sections of the town from electric light. An investigation by local authorities showed that the Pennsylvania Company occupied some streets not covered by its franchise, and that the Lebanon Company, its agent, was operating without any franchise whatever. The village trustees have ordered the Lebanon Company to remove all its wires and poles, and the Pennsylvania Company was directed to vacate all streets not included in its franchise. Drastic action will be taken if the orders are not obeyed.

The American Telephone & Telegraph Company's report of instruments installed and in use during the month of July shows an increase of 13,412 over the corresponding period of last year, and from January 1 to July 31, an increase of 282,996. The total outstanding on July 31, was 5,145,560, against 4,161,517 last year, an increase of 984,043.

Shareholders of the United Telephone & Telegraph Company will vote September 29 upon a proposed increase of the indebtedness from $2,000,000 to $2,350,000.

Telephone Improvements Planned.

The possibility of a new telephone company being formed in Benton Harbor, Mich., by Detroit capitalists, which was mentioned in the issue of ELECTRICITY for August 16, has stirred the board of directors of the local Independent line to action and they have announced that in the next few months not less than $25,000 would be expended in repairs and improvements on the line. The Independent line has over 1,000 'phones in Benton Harbor, and gives connection with 500 'phones of the Bell Company in Detroit, but the service has been abominable and beyond the capacity of the company that thought when it formed the organization that 500 'phones would be all it would ever have in operation.

A recent report from the Stromberg-Carlson Telephone Manufacturing Company of Rochester, N. Y., states that contracts for switchboards have been closed for the following places: Auburn, N. Y.; Bird City, McDonald and Center, Kan.; Coldwater and Arcadia, Mich.; Hannah City, Mulkeytown, Tonica and Lostant, Ill.: Pitman Grove, N. J.; Lewisport, Ky.; Huntingburg, Ind.; Ormsby, Minn.; Seattle, Wash.; Sinclair, Tex.; Mexico, Mo.

Warren H. Girvin, general superintendent of the Central New York Telephone & Telegraph Company, and the Empire State Telephone & Telegraph Company, has tendered his resignation. W. W. Nicholson, who has been assistant general manager of the company with headquarters at Utica, will succeed Mr. Girvin as general superintendent, and the office of assistant general manager, it is said, will be abolished.

Several farmers living southeast of Oak Grove, Mo., are building a telephone line of their own into that town. They have named it the Texas Prairie & Oak Grove Telephone System. By doing much of the work themselves and furnishing most of the material it is estimated that the line will not cost more than $20 per mile.

The stockholders and directors of the Ashville & Panama, N. Y., Telephone & Telegraph Company held a recent meeting at the law offices of Frank H. Mott, and at this meeting these officers were elected: President, G. H. Appleby; vice-president, A. J. Peterson; secretary and treasurer, A. H. Appleby.

It is announced that the Colorado Telephone Company will build telephone buildings in Florence and Canyon City, the construction to begin early next year. About the same time the company will begin rebuilding the entire system in these two cities, and will install the central energy system.

The Ontario, Cal., trustees have decided to advertise for sale a franchise for a telephone line into Ontario.

The sum of $1,000,000 is to be spent by the Zenith Telephone Company of Duluth, Minn., in enlarging its system.

To Increase Automatic 'Phones.

Early in October it is expected that the Illinois Tunnel Company of Chicago will have its bores under the river, connecting the South side with the North and West sides. With the completion of this work Mr. Wheeler says the installation of the automatic telephone will be extended to West and North side subscribers. At the end of five years from the time of the granting of the franchise the company is required by the terms of its ordinance to have 20,000 telephones installed. It has now approximately 10,000. The company is also installing desk or extension instruments. In certain lines of business, where the automatic instrument is known to be in use, it has won much favor from subscribers.

The Secretary of the Interior has entered into a contract with E. A. Hess, of Lyons, Ia., for the construction of a telephone system in connection with the Fort Buford reclamation project in Montana and North Dakota. This system consists of four telephone stations and about 70 miles of pole line.

The Dosbaugh Telephone Company having its headquarters at Sedan, Kan., recently changed its lines from ground to metallic circuits. This company has exchanges at Caney, Peru, Elger, Sedan and Cedar Vale, making about 1,000 subscribers, and represents an investment of about $85,000.

Since deciding to increase the capital stock of the Sandusky, O., Telephone Company to $150,000, the stockholders have concluded to arrange for a refunding of the present indebtedness of the company. A new bond issue will be made to take up all outstanding bonds.

It is said that since the Independent company of Beatrice, Neb., began business there, that the telephone service has been much improved. There are now more than 500 telephones in use by that company.

The Farmers' Mutual Telephone Company of Washington County, Ill., has been formed with a capital of $1,000, to operate a telephone system. The incorporators are J. J. Randall, C. H. Ruhrmester and J McDowell.

The Michigan Telephone Company is extending its line from Bessemer to Sidnaw to connect the Gogebic range with Marquette and the copper country.

The capital stock of the Home Telephone Company of Mobile, Ala., has been increased to $350,000; the sum of $200,000 of this amount will be spent in improving its system.

The capital stock of the Home Telephone Company of Joplin, Mo., was recently increased to $750,000.

An order has been sent out by the Dayton, O., city authorities that all telephone wires are to be placed underground.

The Patterson Telephone Company is building a line into Newport, Ark.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Alvarado, Tex.—The McQuatters Machine & Plumbing Company of Hillsboro has purchased the plant of the Alvarado Light & Power Company, and will enlarge and improve it.

Burlington, Wis.—At a special election in this city the proposition to vote $12,000 for a municipal electric lighting plant was carried.

Calhoun, Ga.—George C. Chambers will erect an electric light plant here to furnish 500 incandescent and 10 arc lamps.

Dublin, Ga.—This city is preparing to improve its electric light plant. The system will be changed from a high to a low frequency. The total cost of the change amounts to $4,000. The change includes a 200 kw. alternator. The voltage will be increased to 2,300 for the incandescent lights and 3,300 for arc lights.

Elm Grove, W. Va.—The Wheeling & Elm Grove Railway Company will make extensive improvements to its plant, installing a complete electric lighting equipment.

Gilroy, Cal.—By a vote of 10 to 1 it was decided to issue $51,000 in bonds for the purpose of constructing sewers, providing water and electric lights and completing the city hall.

Milford, N. J.—W. E. Thomas will establish an electric light plant here to supply both arc and incandescent lights.

Monroe, Ga.—President Joseph S. Walker, of the Electric Supply Company, has closed a contract with the municipal authorities of this city for a complete electric lighting plant. The plant will be the largest lighting outfit in any of the smaller towns in the State, the estimated cost being $20,000. It is proposed to generate current for 4,000 incandescent lights.

Port Townsend, Wash.—A company composed of local capitalists, who was refused an electric light and gas franchise by the city council at the last session, is negotiating with the Port Townsend Electric Company for the purchase of its plant and franchise.

Radford, Va.—The Grayson Electrical Corporation will build a power house at Graysontown, eight miles from here, which will light the towns of Christiansburg, Childress and Riner, and furnish power for a contemplated trolley line from Cambria to Christiansburg, besides such factories as may be established along the line.

Richmond, Va.—H. R. Pollard, Jr., has introduced a resolution before the common council, asking that the matter of erecting a city electric plant be decided by vote of the people.

Rome, Ga.—The City Electric Light Company, of which C. N. Fuller is superintendent, will make improvements to the plant.

San Antonio, Tex.—C. A. Zilker is mentioned in connection with plans for the organization of a company to build another electric light and power plant.

Silver City, N. M.—A franchise has been granted by the city council to George T. Schmelzer and others, who will immediately commence the construction of an up-to-date electric light plant in this city.

St. Augustine, Fla.—The St. John's Light & Power Company has been incorporated with a capital stock of $300,000. to operate an electric light and power plant.

Wadena, Minn.—The city council has recently secured figures on a modern building for the electric lighting plant in this city.

West Branch, Mich.—The electric light and power plant here has been sold to W. W. Vaughan of this city.

STREET RAILWAYS.

Blanchester, O.—The Cincinnati, Milford & Loveland Traction Company, known as the Kroget line, has issued $500,000 of bonds to extend its line to this city.

Brownwood, Tex.—A movement is on foot to build an electric line from this city to Rising Sun.

Claremore, I. T.—A charter for an electric street railway here has been granted to T. S. Chambers, of Blackwell, Oklahoma.

Cleveland, O.—Max Goodman says concerning his Mahoning County traction proposition that he will erect a power house at Teegarden within a short time.

Danville, Va.—There is some talk among North Carolina financiers of building and operating an electric railway line between this city and Yanceyville, N. C.

Georgetown, Col.—E. J. Wilcox, of the Waldorf Mining Company, has under consideration the building of an electric road, which will mean much for Upper Clear Creek.

Joliet, Ill.—Plans for the new electric railway between this city and Wilmington are nearly perfected, and actual work will be commenced in the very near future.

Lorain, O.—In pursuance of its plan to build a belt line to this city the Cleveland & Southwestern Traction Company lately applied to this council for a franchise on certain streets in the western portion of the city.

Marlin, Tex.—Farmers in the section of country between this place and Temple, through which the proposed interurban trolley railway would run are very much interested in the matter, and are anxious that this line be extended from Temple to Marlin.

Newark, O.—After months of expectancy upon the part of business people of this city. the proposed Newark, Martinsburg & Mt. Vernon Street Railway Company has presented a petition to the city council asking for a franchise for the tracks in the streets of this city.

Paris, Ill.—Charles F. Probst lately returned from Chicago, where he was in conference with several capitalists, and says that work on the roadbed of the proposed Paris electric line will be commenced the first of next month.

Peotone, Ill.—A franchise for an electric road through this village has been purchased.

Philadelphia, Pa.—The Germantown & Chestnut Hill Belt Line Railway Company is to form part of an electric line from this city to Trenton.

Spearfish, S. D.—The Black Hills Traction Company has been incorporated to build a trolley line between the towns in the Black Hills.

Toledo, O.—The Lima & Toledo Traction Company has increased its capital from $50,000 to $3,000,000. W. K. Schoepf, of Cincinnati, is president.

Utica, N. Y.—Work will commence in one week on the electrification of the West Shore Railroad between Syracuse and this city.

POWER PLANTS.

Anderson, S. C.—The stockholders of the new Hatton's Ford Power Company recently affected a formal organization by electing the following officers: R. S. Ligon, president and treasurer; J. A. Brock, vice-president, and J. C. Green, secretary. Hatton's Shoals is 16 miles from this city on the Tugaloo River, near its confluence with the Savannah. It is estimated that 6,000 hp. can be developed. The company is capitalized at $150,000, and will develop power for lighting and manufacturing purposes. Work on the plant will begin at an early day.

Pomona, Cal.—Farmers and orange growers in this vicinity are organizing a company to build an electric power plant, with which they expect to furnish power for all pumping plants in the vicinity, and operate a trolley belt line, connecting all the nearby towns and ranches.

York, Pa.—A mortgage for $10,000,000 was filed in the recorder's office here last week to secure a bond issue to be made by the McCall's Ferry Power Company, a corporation of New York capitalists, who purpose building a power plant on the lower Susquehanna River, near McCall's Ferry, Pa. The Knickerbocker Trust Company of New York is named in the mortgage as trustee for the bondholders. The mortgage covers real estate along the river in York and Lancaster Counties, Pennsylvania, and Cecil and Harford Counties, Maryland, as well as securities in companies that have been consolidated in the power company.

BIDS WANTED.

Washington, D. C.—Proposals will be received at the Bureau of Supplies and Accounts of the Navy Department, until August 29, for the delivery and installation of three water tube boilers and machinery for the power house at the Naval Hospital. Blank proposals will be furnished upon application to the Bureau, H. T. B. Harris, Paymaster General, United States Navy.—Sealed proposals will be received by the Department of the Interior at the office of Elliott Woods, Superintendent of the United States Capitol Building and Grounds, until September 30, for furnishing all material, labor and other appliances, and erecting and putting in operation, in a building and on foundations to be provided by the United States, and in locations within the Capitol Building, Congressional Library Building, and Senate and House Office Buildings, now under consideration, a complete heating, lighting and power plant, including machinery, boilers, piping, electrical transmission, cables and conduits, appliances and all other equipment in said power house building, and in the other buidings named. Thomas Ryan, Acting Secretary.

Winnipeg, Man.—Sealed tenders addressed to Alderman J. C. Gibson, chairman of the fire, water and light committee, will be received until 3:30 P.M. August 28, for a 500 kilo watt electric generating plant.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 15¾@16c.; Lake 15¾@16c.; casting, 15⅜@15⅝c.

Mayor Dunne and the Chicago street car companies failed to agree on anything at the recent conferences.

The Hudson Tunnel Company is negotiating with the Public Service Corporation of New Jersey for power to operate its cars under the river.

The Chicago & Milwaukee Electric Railroad Company announces that it will open the Zion City extension of its Evanston-Waukegan line August 26.

A Philadelphia official of the Electric Company of America says that the earnings are showing good increases over last year, especially the Atlantic City lines.

For the first twenty days in August the reported earnings of the Boston & Worcester Street Railway Company show an increase of 20 per cent. over August of last year, which is double the estimated increase.

The General Electric Company has purchased $100,000 of the bonds of the Bristol Light & Railway Company, a Virginia concern, the securities of which corporation are listed on the Washington, D. C., Stock Exchange.

It has often been noted that in active bull markets Westinghouse Electric crosses General Electric's price. Dealers in Westinghouse say that it is rather mysterious why the stock is now selling 14 points below General Electric.

Interests connected with the New York Air Brake Company have secured control of the United States Light & Heating Company, a concern which aims to furnish electric light and heat to railway cars by the Moskowitz system of transmitting power from the axle.

It is indicated by the quarterly report of the Interborough Company that not fewer than 300,000 persons traveled on the New York Subway every day on the average, although it is not possible to get the exact figures for the time the underground road has been in operation.

The Lehigh Valley Traction, the Philadelphia & Lehigh Valley, Allentown & Slatington, Copley and the Egypt & Ironton Companies have been consolidated into one traction system, to be known as the Lehigh Valley Transit Company. The total capitalization is $20,500,000.

Municipal ownership advocates received a severe blow on Saturday by a decision rendered at Indianapolis by Judge Francis E. Baker, of the United Circuit Court, holding that cities have no power to take over the property of public utility corporations, even when the right is stipulated in the franchise.

President Winter of the Brooklyn Rapid Transit Company informs large stockholders that if the directors of the company will give him one more year to work out the Brooklyn transit problem, without restricting his expenditures for the improvement of the property, there will be no longer any question as to dividends for the stock for years to come.

Four Boston-controlled traction properties in Indiana and Ohio have been sold by the owners to the United Gas Improvement Company of Philadelphia. The four are the Indianapolis & Northwestern Traction Company; the Columbus, Buckeye Lake & Newark; the Indianapolis & Western, and the Columbus, Newark & Zanesville, all built and managed by Tucker, Anthony & Co. It is understood that the sale involved the transfer of about $14,000,000 in cash and securities. The stocks were all sold for cash.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price Aug. 21
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	215½
Manhattan Elevated Railway	167
Metropolitan Street Railway	129¾
Metropolitan Securities	83¼
Ninth Avenue	197
Third Avenue	128
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	69⅝
Brooklyn City Railway	239
New Orleans Railway	30¼
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81¾
Philadelphia Traction	100½
Union Traction	60
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	19½
do. do. do. pref	62
West End Street, com	97¼
do. do. do pref	114
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	8¾
do. do. pref.	37

ELECTRIC MANUFACTURING COMPANIES' STOCKS.

Name.	Closing price Aug. 21
New York City.	
Allis-Chalmers, com	17¼
do. pref.	57
Electric Boat, com	32
do. do. pref.	72
Electric Vehicle, com	18
do. do. pref.	20
Westinghouse, com	170
do. pref.	190
General Electric	184
Boston.	
Edison Electric Illuminating	256
General Electric	184
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	155
National Carbon, com	60¼
do. do. pref.	118
Philadelphia.	
Electric Company of America	11⅝
Electric Storage Battery, com	83
do. do. do. pref.	83

TELEPHONE AND TELEGRAPH STOCKS.

Name.	Closing price Aug. 21
Boston.	
American Telephone & Telegraph Company	143
Western Telephone Company	17½
New England Telephone Company	184½
New York.	
American Telegraph & Cable Company	190½
Commercial Cable Company	210½
Mexican Telephone Company	½
New York & New Jersey Telephone Company	179¾
Postal Telegraph Cable Company	..
Western Union Telegraph Company	94
Chicago Telephone Company	131

MISCELLANEOUS STOCKS.

Name.	Closing price Aug. 21
Chicago Subway	84⅝
Otis Elevator Company	66
Standard Underground Cable	..
Twin City Rapid Transit	118⅝

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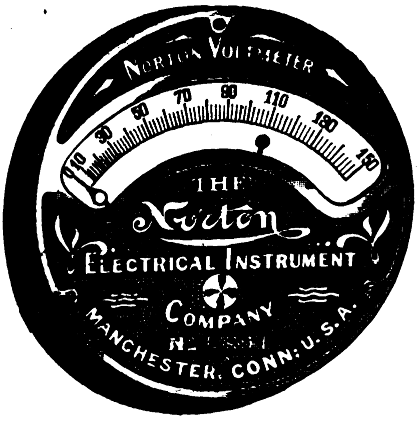
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THE Norton ELECTRICAL INSTRUMENT COMPANY
MANCHESTER, CONN: U.S.A.

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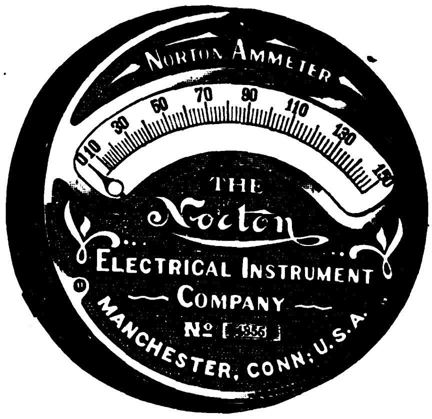
0 to 750 volts.
0 to 10 amperes.
0 to 1500 amperes.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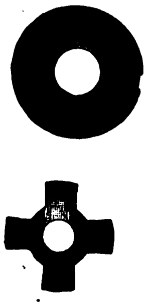

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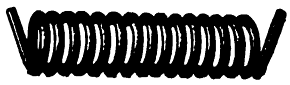

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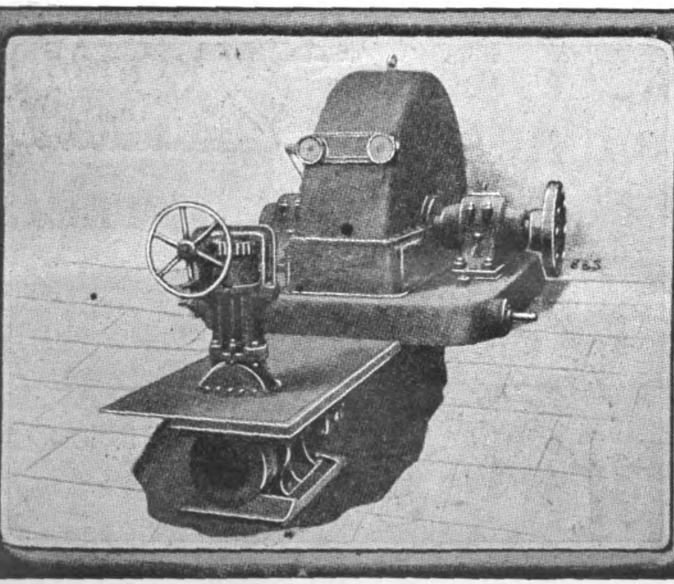
PEORIA, ILL., U.S.A.

DIRECT CURRENT.



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ELECTRICITY.

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EDITORIAL NOTES.

The Returns from Engineering. The returns from engineering seem all on one side, so far as the average engineer is concerned. There are three phases of money-making involved in the art and practice of engineering: first, the professional end, consisting of consultation or the employment of such knowledge as is of a purely technical or scientific nature; second, the manufacturing end, in which devices are made to fill certain prominent demands, and third, the constructive or installing end, in which contracts are filled as indicated by certain specifications. There might be a fourth, but it could not belong to engineering, although the result of it. This is the position of the stock or bondholder of an electric company. His attitude is purely passive, yet his interests are better protected and larger than the returns of those representing the *deux machina.* The engineer is not a well paid man, as may be judged from his modest income and superfluity of knowledge pertaining to his science. In law, medicine or the practice of some other crafts, the remuneration is immense in comparison, but the difficulty is largely one which relates to the employment of the knowledge. If we were all masters there would be no workers, and for this reason the cultivation of these talents, which lead to a superior aptitude in management or invention cannot be discovered in more than a few. The few are thus financially more successful than the many. The few are the representatives of the profession simply because they possessed superior qualifications. But take the knowledge, skill, judgment and intellectuality of the best of consulting engineers or even of the so-called practical engineers, those that head the largest of corporations, and compare their returns with the flood of wealth circling around the doors of the eminent lawyer or physician. The public judgment seems to be biased. They are accustomed to paying the engineer badly. The combination of the commercial with the technical is unquestionably most productive, yet those not born with business ability, those in fact from whom the greatest gifts the world has received have come, are not given an equal show. Competition may be used as an argument but it must be remembered that it applies to all professional fields as well. It might be suggested by the thoughtful, that all doctors and lawyers are not well paid. This is not the point, however. The tribute paid to engineering knowledge and its concomitant responsibilities is not equitable. The returns from engineering are not in proportion the equivalent of those yielded to others, not more skillful or useful to the community than the engineer, and certainly not as indispensable.

* * *

Public Utilities and Their Unsightliness. There is nothing condemnatory in the opinion expressed that many of our public utilities are unsightly. The conflict has ever been waged between the purely practical man and the owner of artistic sensibilities. The French regard appearance as of equal importance to existence, and in consequence have made it a criminal offense to offend the public taste by unsightly structures. An art and building commission combined pass upon the structures to be erected, and it is their decision which controls the architectural beauty of Paris. We only express our protests in a plutocratic form. Complaints against unsightliness in things about the city rarely if ever come from the poor. They generally emanate from the richer classes of society, to whom the preservation of good appearances is historically a matter of greater importance, and it may be added, it is more within the circle of their activities to give time to the consideration of such matters. On the other hand, the risks arising through the continued presence of unsightly objects, such as poles and wires—of shock and injury—have been determining factors.

The town of Somerville, N. J., has suggested a condition of affairs along the lines indicated, and the public press have made news of the situation. The New York "Sun" states as follows: "The rich folk of the New York colony do not like to see telephone and electric light poles along the country roads, and they are taking action to have all wires placed underground." The notification of the electric light company, by the members of this colony, that it must desist from what they consider to be a desecration of their surroundings, gives rise to an interesting condition of affairs. It can be readily perceived that the expense involved in carrying out a project of this kind, namely, the interment of the wires, which would include those of the telephone company as well, would mount up to comparatively high figures. The fact that this expense would have to be incurred solely for the purpose of satisfying the æsthetic tastes of this community, does not seem just. The possibility of the expense of this enterprise being properly divided up between the individual colonists and the electric light and telephone companies, is the other issue presented. As far as the correct view of what would be considered adjudication is concerned, these matters will adjust themselves eventually with satisfaction to both parties. But the further ultimatum, that the colonization of Italians in the district and the erection of trolley roads will not be permitted, brings us face to face with a phase of fanaticism that overrides all our American traditions. These sporadic outbursts of æstheticism would be just if they represented a national feeling. But the question of utility is the most important one in the public mind. That necessity knows no law is to some extent the watchword which determines much of American success. The validity of a claim, presented by a limited community against the introduction of modern utilities in the customary manner, must be weighed with reference to the nature of the community, and the influence of a checkmate upon the potential growth of other communities. If appearances can be improved upon, where wires are laid, it is far better to start with this idea in the first place. But who but the supersensitive complain about wires stretched along country roads. And when we consider the value of the trolley to the suburbanite of limited income the element of injustice seems very apparent.

It will be interesting not only to see the outcome of this argument, if taken to court, but to see to what extent the battle will be waged by the more practical interests involved.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

An official trial was made about two weeks ago at Dover, England, of the systems of submarine signaling by bells under water, inaugurated by the Submarine Signaling Company of Boston. The trial was successful, the strokes of the bell being distinctly heard at a distance of three miles.

◆

A cable dispatch from Brussels, August 26, says that actual work has been started on the construction of the fastest long-distance railroad in the world. The road will be run from Bussels to Berlin via Cologne and trains are to be run at a minimum speed of 120 miles an hour. The track will be without a single curve, and the motive power electricity. The amount contributed by the Belgian Government toward the cost of construction and equipment will be $11,250,000,

◆

An imperial edict declares that telephones and wireless telegraphs throughout China are Government monopolies.

◆

A dispatch from San Francisco says that a new wireless instrument weighing only 1½ pounds and found by exhaustive tests to give better results than the more cumbersome machines now in use, has been invented at the Benicia Barracks by Hugh Annis, a young soldier of the Signal Corps.

◆

Consul Shank, of Winnipeg, Canada, reports to the State Department at Washington that scientific circles are interested in the discovery of a process for welding copper, which has been made by a Winnipeg blacksmith. It is said the process has been thoroughly tested and found perfect, and that copper can be welded to copper or other metals without impairing the electrical conductivity and other properties of the metal. The process is said to be very simple and not more costly than the welding of steel. The work can be done with a forge, a blowpipe or any other apparatus which will heat the metal cherry red.

◆

There is said to be a strong tendency in Germany to abandon the conduit and storage battery system in favor of the overhead trolley for street railways, principally for reasons of economy. Mixed working by trolley and cars provided with storage batteries is retained only in Dresden, while trolley working in conjunction with sections of conduit line exists in Berlin, Dresden and Dusseldorf. The reliability of the conduit system, as compared with that of the overhead trolley line, leaves much to be desired, according to German experience, so that its entire substitution by the last-named is apparently only a question of time.

◆

A cable dispatch says the municipality of Vienna has decided that all public clocks shall be regulated by electricity. The current will be sent by the wireless system fron a central station to 80 small receiving stations scattered about the city and will then be transmitted by wire to the clocks. The municipality will regulate clocks in private houses in the same manner, charging a small fee for the service.

◆

By the use of electricity an English firm is transforming peat into a hard combustible suitable for use under boilers. It is said to produce much heat and little smoke.

◆

Mr. Albert S. Richey has been appointed assistant professor of electric railway engineering at Worcester Polytechnic Institute, Worcester, Mass. Mr. Richey graduated from Purdue University in 1894, having followed the course in electrical engineering.

◆

The Lehigh Coal & Navigation Company has begun the work of electrifying its mines at Lansford, Pa. Electricians are now running lines to the No. 5 colliery, No. 4 slope, No. 6 breaker and No. 5 tunnel. Two electric locomotives will arrive shortly. The work of installing the lighting system in the mines will be completed by the end of the year. The company is erecting a 1,000 hp. electric plant at Lansford.

◆

A London cable says that Charles T. Yerkes went to Paris Saturday, He has had a wonderful recovery in health after having been given up by two eminent specialists.

AN ELECTRIC AERIAL FERRY.

BY FRANK C. PERKINS.

The accompanying illustration shows a most unique and interesting type of bridge of American construction, known as the aerial ferry, as it is now in operation crossing the Duluth Ship Canal, through which passes annually twice the commercial tonnage that is carried through the famous Suez Canal. For the past two decades the city of Duluth has been endeavoring to find a safe, practical and economical method of carrying passengers across the canal. Plans were prepared for a bridge over the canal at a cost of somewhat less than $500,000, and tunneling was also proposed, but the estimate of cost was so high that the scheme was dropped immediately as the plan called for a subway tunnel for use of railroads, street cars, highway and passenger at an expense of more than $1,000,000.

A number of committees were sent to Washington to prevail on the Government officials to allow a drawbridge to be constructed, but the appeals to the board of engineers of the War Department were unavailing, and this plan was also abandoned.

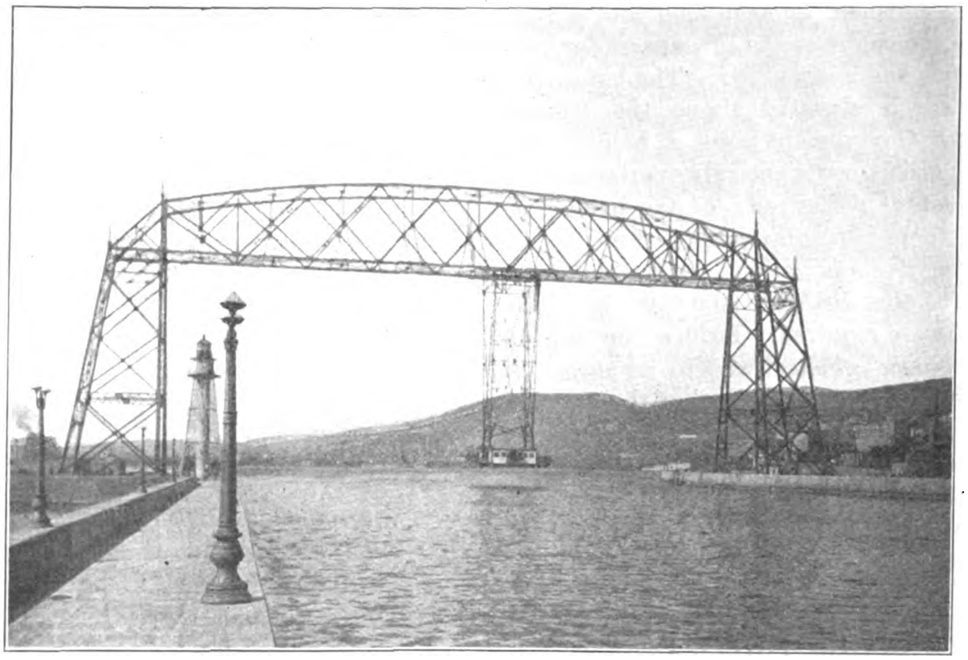
This new electric aerial ferry now in operation at the Duluth Ship Canal is only similar in purpose to the suspended car transfer bridge at Rouen, France. Electric motors are utilized for supplying the necessary power for moving the ferry car, the current being supplied by two separate cable systems from two distinct companies. By means of a switch provided for the purpose and under the control of the bridge operator, if one source of current fails, it is possible for him to turn on the power from the other, and a further safeguard against delays is provided by an adequate hand power which can be employed in case both sources of electric energy fail.

The suspended ferry car has a normal speed of about four miles per hour, but the electrical motors and driving equipment is capable of propelling the car at twice that speed should it become desirble and the passage of the canal can be made by the supended ferry car in slightly over one minute.

There are two electric motors, each of 50 hp. capacity, located under the floors of the car. These electric motors operate two drums, each of which is 9 feet in diameter and on these drums are wound cables 1 inch in diameter extending to the truss and then over idle wheels 9 feet in diameter through the inside of the lower chords to the tower where they are fastened and thus produce the motion which causes the car to travel across the canal,

The canal was adopted by the United States Government about four years ago, increasing its width from 240 to 300 feet, and constructing permanent piers of cribwork and concrete. Minnesota Point was converted into an island by the opening of the canal, and the city accepted the responsibility of providing the inhabitants with adequate communication with the mainland. A rowboat ferry was first maintained, and finally a steam ferry for the transportation of passengers and freight across the canal was substituted.

The imperative necessity of better communication with the Point at a less cost than was being paid for the steam ferry service resulted in the inception of the aerial bridge scheme.



Electric Aerial Ferry on the Duluth Ship Canal.

The idea of the aerial bridge over the Duluth ship canal was received with favor by the United States War Department, and a bond issue by the city of Duluth for the amount of $100,000, the estimated cost of the structure, was sanctioned by the State Legislature and approved by the citizens, and a general specification and contract was prepared and let for the erection of the bridge about four years ago.

Under this original contract the concrete piers for the bridge structure were built, and then the work was abandoned by the company holding the contract. About a year ago the Modern Steel Structural Company of Waukesha, Wis., who has just completed the bridge, entered into a contract for a riveted truss on riveted steel towers as shown in the accompanying illustration, the ferry car to be supported by an inverted truck, as it might be called, and the work was completed according to these plans.

A most ingenious arrangement of the track has been provided to carry the car and hangers. It is inclosed on three sides within the box section of the lower chord and hence there is no danger in the winter of its becoming coated with sleet or snow. Within the chords there are four rails, two in each, with 32 wheels arranged in pairs rolling on the rails and carrying the truck, eight pairs of wheels being employed on each lower chord. The friction of all the working machinery is reduced to a minimum, as the bearings of these wheels, as well as those of the drums and idlers, are of the roller type. On account of the use of roller bearings, the mechanism works very easily and the hand power method of propulsion can be employed without serious difficulty. This is applied by the use of lever handles which are geared to the rim of the drums on the car. It is stated that the cost of operation of this electrically operated aerial ferry bridge will not exceed $7,500 per annum, including the interest on the bonds, which will result in a saving of one-third the cost of the steam ferry boat service previously mentioned.

The four principal piers nearest the canal rest on grillage which is secured on the tops of piling driven 35 feet below the level of the lake, while in the foundations of the bridge there are 730 tons of concrete in the eight piers which extend below the water level of Lake Superior. The towers are held in position by 24 anchor bolts, each of which measures 2 inches in diameter and fastened by large washers to the bottom of the pier. There is a clear height above the ordinary stage of Lake Superior of 135 feet, the height of the bridge being fixed by the Lake Carriers' Association to permit the passage of the highest masts. The total height of the highest part of the bridge above the water is 186 feet, and the depth of the truss at the center is 51 feet, while the width center to center of the trusses is 34 feet, the clear span being 393.75 feet.

It is stated that the car will carry a loaded double truck street car, 350 passengers and two loaded wagons with teams, which is equivalent to about 63 tons, with perfect safety. The car platform measures 50 feet long and 34 feet wide, and contains two inclosed cabins finely finished, 30 feet long and 7 feet wide, in addition to the space for two wagons and a street car. The bottom of the car is elevated above the United States Government piers a height of 6 feet, and it rests entirely overland when at rest at either end of the bridge, so that there is no obstruction or menace in any way to navigation. In the construction of this bridge 1,400,000 pounds of steel were required. Before the last 45 foot piece of steel was to be placed in position, it was found that the opening was 3 inches too narrow. The workmen stood guard with tape lines at a height of 135 feet, while both halves of this massive structure were tilted back, enlarging the opening.

AN AUSTRIAN INDUCTIVE TELEPHONE TRUNK LINE.*

An interesting article by Herr R. Nowotny, which appeared in the Vienna "Zeitschrift fur Elektrotechnik" some time ago, describes a successful experiment made in Austria on the insertion of inductance coils in long telephone lines. The line in question is from Vienna to Innsbruck, a distance of 354 miles, and, being a new one, it was designed from the outset on this system. According to past experience, a 4 mm. (0.1575 in.) bronze wire would have been necessary on the ordinary system, while it was anticipated that 3 mm. (0.1181 in.) would be sufficient diameter for the wire if inductance coils were inserted at intervals; this represented a considerable gain in economy.

For the greater part of the route the existing poles of the telegraph and telephone administration could be utilized for the new line, only 33 miles of new pole route being required. The first 6.4 miles of the line were formed by a pair of wires in an existing paper-insulated underground cable, and there are three other lengths of cable on the route, one 1⅞ miles in length, the second about the same length, and the third 220 yards long. Inductance coils were employed in all the cable sections, with the exception of the 220 yards length, as well as on the overhead line.

The overhead wire itself was erected in accordance with the usual practice of the Austrian telephone administration for interurban work. This implied crossing the two wires of the pair generally at every eighth pole. The wire is of bronze, 3 mm. (0.1181 in.) diameter, except in some Alpine districts in which a compound wire was employed 3 mm. in diameter and with an absolute breaking strength of 1,170 lbs. In some places also it was necessary to employ a lighter wire 2 mm. (0.0787 in.) bronze or compound.

The inductance coils were supplied by Messrs. Siemens & Halske's Vienna branch, who are the owners of Prof. Pupin's Austrian patent. The coils for the overhead line had each a resistance of 1.2 ohms, and an inductance of 0.08 henry, and they were placed at distances of 4 km. (2½ miles) apart on each wire of the loop. To carry the coils it was found possible to employ the pattern of bracket and insulator used by the Austrian telegraph service for branchings with but little alteration. The method of supporting the coil is shown in Fig. 1. The insulators J and J_1 carry the line wire. On J there is a pot-shaped insulator, J_2, in which the inductance coil is embedded in paraffin, while on the second insulator J_1 is fastened an ebonite bell, H, containing the vacuum lighting protector, which is shunted to the inductance coil. It was necessary to erect the line first without the inductance coils, as the latter were not ready for delivery. In order to save soldering the joints when the coils were subsequently inserted, sleeves were employed on the Arld principle. These are short copper sleeves for 2 mm. or 3 mm. wire, which are passed over the ends of the wires at h and h_1, and then twisted round the wire from the middle outwards by means of a special tool. Fig. 2 shows diagrammatically the connection of the inductance coil and lightning arrester. The dotted line represents a short-circuiting wire, which was employed for the tests described later.

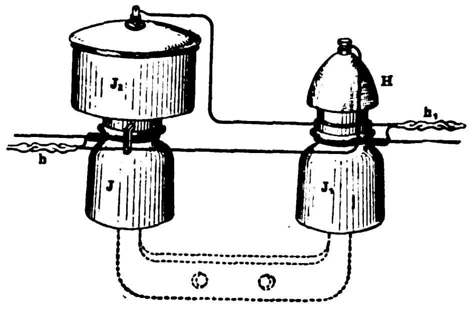


FIG. 1.

The inductance coils on the cable part of the line differed to some extent from those on the overhead line, the two coils on the two wires being wound upon the same iron core in this case, while on the overhead line the coils on the two wires were separate, each being contained in its own insulator pot and each being provided with its own lightning arrester. The resistance of the double coils on the cable was 2.5 ohms and their inductance 0.2 henry. These coils were spaced at distances of 1,250 meters (1,370 yards) apart, and it was so arranged that they were placed at the ordinary joints in the cable, the junction boxes being made sufficiently roomy to take the coils also, and the work of adding the coils to the wires used for the new line did not interfere with the continuous working of the other wires of the cables.

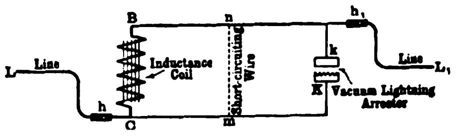


FIG. 2.

In the first instance, speaking tests were made with all the coils on the overhead line short-circuited—the few coils in the underground lines were left in. It was found possible to speak between the Vienna and Innsbruck exchanges with some difficulty and even to speak from an instrument connected directly across the line at Vienna to single-wire subscribers at Innsbruck. It was not found possible in most instances, however, to enable subscribers in Vienna to talk with subscribers in Innsbruck. An experiment was then tried to ascertain the effect of the 10.3 km. (6.4 miles) cable at the Vienna end of the line. This was replaced with a cable of the same length and size not equipped with inductance coils, and there was then a distinct weakening of speech. The same conclusion was come to by using part of the new line between Vienna and Salzburg (330 km.; 188 miles) in connection with the coil-equipped cable and comparing it with another telephone line between the two points. Although one-third of the latter line was of 4 mm. wire and two-thirds of 3 mm. wire, and the new line was of 3 mm. for its whole length, as already stated, the new line gave clearer speaking than the old.

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* From the "Electrician." London.

The next test was made on the entire length of the new line from Vienna to Innsbruck, but with every second inductance coil short-circuited on the overhead part, so that the coils were only connected in every 8 km. (5 miles). It may be mentioned that speaking tests were also carried out during the process of removing the short-circuiting wires, and it was found that after this work was commenced and the inductances were, therefore, connected irregularly, speaking on the line became much worse, the voice sounding muffled with an absence of sibilants, but as the work of connecting in the coils proceeded, speech improved. Tests then carried out—with the inductance coils at 8 km. (5 miles) intervals showed that loud and clear speech was possible between the two towns, and that subscribers could be connected with very good results. When the mouth was 57 cm. (22½ in) from the microphone at Innsbruck words spoken with ordinary loudness could be heard in Vienna. It was even possible to speak between Innsbruck and Cracow (1,000 km.; 621 miles), although the voices then became very weak, but on extending the line further, to Lemberg—1,350 km. (838 miles) from Innsbruck—speech was no longer possible.

The remaining short-circuiting wires were now removed so that the inductance coils were only spaced at 4 km. (2½-miles) intervals. It was found that the improvement in speech between Innsbruck and Vienna was quite insignificant and the only result was slightly better speech between Innsbruck and Cracow; it was still impossible to talk from Innsbruck to Lemberg. Moreover, when tests were made as before to see what distance the mouth could be removed from the microphone mouthpiece without rendering speech unintelligible, the same result was obtained as with half the inductance coils in use.

A comparison was also made between the new line and a 4-mm. bronze line from Vienna to Trieste, 321 miles long—that is to say, of almost equal length. Speaking was equally good over the two lines in spite of the difference in sectional area. As it will be necessary in practice to interconnect the existing non-inductive lines with sections of the new line, a speaking test was made from Salzburg to Trieste, using the new line from Salzburg to Vienna (188 miles) and the 4-mm. line just mentioned from Vienna on to Trieste. The result was all that could be desired and it was possible to hear well at Trieste when the mouth of the operator at Salzburg was 7⅞ in. from the microphone mouthpiece. Similar tests were made with other lines in conjunction with the new one and the results were satisfactory in every case.

While all these experiments were being carried out an endeavor was made, in conjunction with the representatives of Messrs. Siemens & Halske, to obtain some quantitative results with the aid of high frequency currents. Currents of 8 milliamperes at different frequencies were sent into the line at the Vienna end and the received current was measured at Innsbruck and Salzburg with the aid of a mirror galvanometer. The results of these measurements are shown in Fig. 3. Curves I to VI apply to the whole 354 miles from Vienna to Innsbruck, and curve VII to the part from Vienna to Salzburg only (188 miles). During the tests with the coils all short-circuited, shown in curves I, II and III, the insulation resistance per kilometer of single conductor was 41.5, 25.5 and 18.5 megohms per kilometer respectively. Curve IV gives the results with half the coils only in circuit, and during this test the insulation resistance was 46.5 megohms per kilometer of single line. Curves V and VI, which, it will be seen, are for the line with all the coils in circuit, were taken when the insulation resistance was 12.25 and 9.5 megohms respectively per kilometer of single line; and the part of the line from Vienna to Salzburg had an insulation resistance of 25 megohms per kilometer of single line when curve VII was taken.

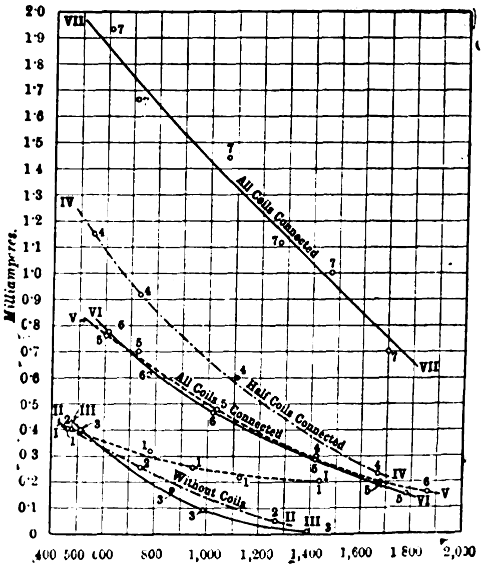

FIG. 3.

The increase of the received current when the coils are in circuit is apparent from these curves, and it is also seen that this is less marked the higher the frequency. This would indicate a considerable weakening of the overtones of the voice, which, however, was not observable in practice. The author ascribes this partly to the impedance of the receiving apparatus, and partly to the fact that larger currents have to be used for the quantitative tests than for actual telephony, while the inductance of the coils is calculated for the telephoning conditions.

The most noticeable feature in the curves, however, is the fact that larger currents were received when only half the coils were in use, this being the more marked the lower the frequency. The paper concludes with a theoretical investigation as to the effect of the insulation upon the working of the line, from which it is concluded that, in damp weather, when the insulation resistance of the line is low, there should be little difference in the effect of coils spaced at 4 km. and coils at 8 km. apart. As in the tests under the former conditions the insulation resistance of the line happened to be lower, the author concludes that the theoretical and practical results are in agreement.

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NOTES ON EQUIPMENT FOR ELECTRIC CRANES.

BY W. H. WAKEMAN.

Many foundries and machine shops are equipped with cranes for handling heavy castings and machines and the owners of others are contemplating similar improvements, for they must do it whether they wish to or not, for without proper facilities it is impossible to compete with those who are prepared to work by aid of best modern appliances.

Having laid plans for equipping a foundry with electrical appliances, including a crane, care should be taken to install one large enough to do the work properly. There will be no trouble about lighter castings but how about the heavier pieces which are sure to be wanted sooner or later?

The tendency is to get machinery that soon proves too light for urgent needs, resulting in chagrin, disappointment and loss. Men who have not had experience along these lines seem to think it almost impossible to make a serious error, and yet it is a very easy matter to accomplish.

If the heaviest casting that is made in a certain foundry weighs 15 tons, then it seems necessary to order a crane that will lift it and that will suffice, but that is not enough. Has it ever occurred to you that when your large casting is first lifted from its bed, the heavy cores must be lifted too, also much sand and loam will cling to it, and in addition to this it will require much force to overcome the natural "stick" of the casting to the mould?

All of this extra duty will require about as much strength of construction and power of crane as to lift the finished casting, therefore if the latter weighs 15 tons, calculations should be made for at least 25 tons, and 30 will be better.

Another point bearing on this matter is that in some foundries it is desirable not only to lift the whole mass of molten metal, but the ladle and appliances used with it must be raised at the same time, for even quite large castings are all poured from one heat.

Furthermore, in this age we must look for advancement and not backward movements, therefore provision should be made for heavier work and less hand labor than ever before.

The term "strength of construction" above used refers to foundations for buildings which must also support the heavy steel girders required, also the cranes and their full load. When we consider the shallow foundations, thin walls, and slender roofs that answered every purpose 20 years ago for foundries that did prosperous business, the difference will be apparent. Now everything must be of the most substantial character or it will fail, and such failures usually come when they cause the most damage, by lost time and ruined material.

At the present time no shop where lathes, planers and drill presses are used, can be considered up-to-date unless it is fitted with one or more electric cranes with which to handle the rough castings and finished product. It may be a large repair shop or works where machine tools are made. This makes it necessary to install a generator to supply the current, unless it is more desirable for some special reason to buy it from the local electric light company or a convenient trolley line.

In the latter case it is usually necessary to deal with about 550 volts potential, therefore calculations must be made accordingly. As a general rule, to which there may be a few exceptions, it is better to use a rotary transformer and reduce the potential to 110 volts. Reasons for this are found in the fact that the lower tension is safer for general use and much more convenient for incandescent lighting purposes. Buying current from other parties is not always satisfactory although it may be advisable for a time, but as a rule one man can generate current about as cheap as another in the same locality, therefore it is well to buy a crane motor that is suited to the current that will be used when the crane owner runs his own generator. If he expects to generate current at 550 volts, then buy a crane motor designed for it, and use the trolley pressure for present purposes just as it comes.

My idea in presenting this is to suggest that it be investigated from all points of view, rather than to lay down a cast-iron rule that might not apply to all cases.

In some foundries, and of course in all machine shops, power of some kind is used and it is generally supplied by a steam engine. When an electric crane is contemplated the proprietor expects to install a generator under these conditions and run it just as he would another lathe and get all the current he needs. If the shop was formerly lighted by gas, he considers it a good time to install electric lights instead.

It is surprising to note how many men will lay down plans for such changes without knowing whether they have power enough to do it or not. They seem to think that as it is a steam engine there is practically no limit to the power it will develop if wanted. This is certainly a mistaken idea on general principles, and will cause trouble in every case where the engine already has a full load. Let a test be made by a competent engineer to determine this point.

If there is not a surplus of power available sufficient to drive the generator with a full load it may be advisable to install a separate engine for this purpose. One advantage of this plan is that light can be furnished to finish work in the foundry, after power is no longer wanted, without running the shafting, belts and loose pulleys, also when repairs are to be made to any other part of the plant.

Where the engine already in use is large enough to drive the new generator, it is sometimes considered sufficient to belt it without using a clutch or a loose pulley to stop it when required without shutting down the engine. The owner claims that the generator should always run, in order to provide current so that it may be used without notice.

This is correct in theory but not always practical, because a bearing on the generator may become heated so that it must be shut down for a short time, or it may be desirable to stop it for other reasons, therefore provision should be made for such needs.

Wherever such a crane is to be used in a shop the span should be long enough to cover the entire width of room. In some cases it is made to cover only the central part, but it proves unsatisfactory in practice, because heavy castings and finished machinery must be put on rollers and barred over to the walls, if not wanted for immediate use, making much unsatisfactory labor.

Furthermore, it ought to be made to lift anything made in that shop high enough to back a wagon under it, for this will save much expense in loading and unloading.

When the owner of a shop decides that he must have an electric crane, it is a good idea to investigate the work done along this line by a firm that makes a specialty of this work, and if they can show successful installations in other places they will probably do satisfactory work in your case. Of course it may cost more at first than to patronize somebody who has a nondescript motor to sell, and is sure that he could design a crane although he has never tried it, but it will pay better in the long run.

The speed regulation of the lifting motor on an electric crane should be different from that employed in regular power transmitting equipment, as it should run slowly with a heavy load and speed up in proportion as it is made less. The design should permit of doing this without excessive waste of electrical energy in regulating devices whatever they may be, and the whole should be automatic in operation.

Direct current series wound motors seem to be well adapted to this service as they have increased torque (or turning power) when the speed is reduced by increase of load. For this reason the shaft of such a motor should be larger in diameter than for other motors of the same rated power on other work.

A motor for this service should be wholly inclosed in a cast-iron case to exclude flying dust and dirt, yet facilities for reaching every part of it are necessary.

One bad feature of this system is that bare wires must be used for the trolley, as otherwise current could not be utilized. This is dangerous because other wires may be crossed with them accidentally, or they may come into contact with some of the metal work, resulting in a serious ground or a short circuit, which will cause the shop to be burned to the ground before the fire is subdued.

On this account and for other reasons fuses that are of only slightly greater capacity than are actually required should be used, as they will quickly melt in case of trouble of this kind. Wire of any other kind should never be used in place of fuse wire, yet copper wire is put in where the softer kinds burn out occasionally in order to save trouble in renewing them, but this is exceedingly bad practice and ought to be prohibited in all cases.

When a fuse goes out it will stop the crane as a matter of course, but an efficient brake should always be in use that will hold the load until repairs are made.

ELECTRICITY LEAFLETS.

BY NEWTON HARRISON, E. E.

(*Concluded.*)

INCANDESCENT FILAMENT AND TUBE LAMPS.

The Foundation of High Illumination.—The construction of modern lamps is based upon certain simple principles, derived from an examination of special scientific requirements. These requirements are in themselves derived from the conditions of daily practice, the qualities of materials that are useful in lamp construction, and the limitations imposed by the question of personal risk in the use of a given pressure. Lamps employing a filament are simply cases of where the electrical energy is allowed to act upon a screen or material resisting rapid deterioration under the influence of high temperature. The evolutionary character of the work done to date well illustrates the gradual development of the lamp, to which electricity is applied, into its present tube form. The idea may be represented as follows:

1—The incandescent metal filament in air.

2—The incandescent metal filament in a vacuum.

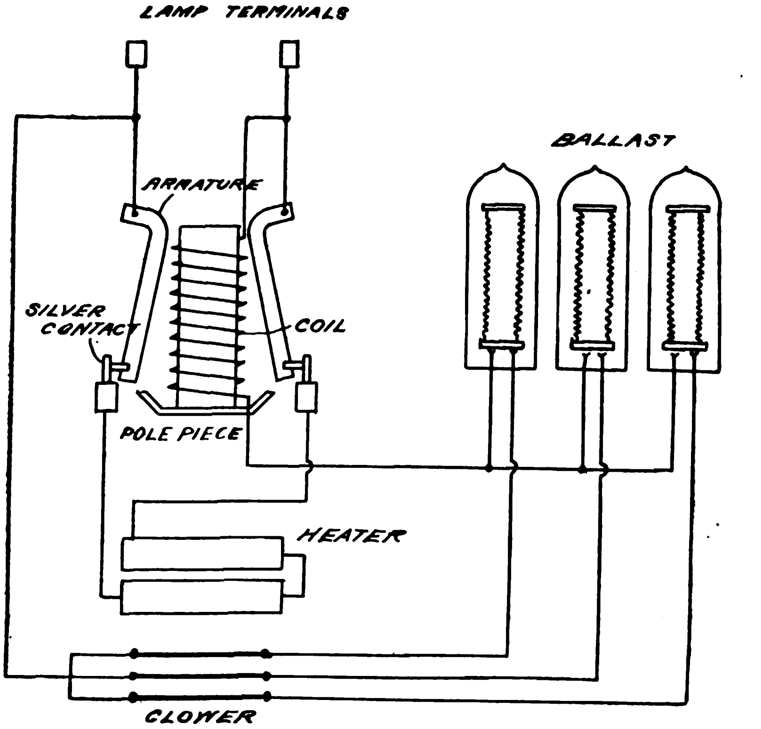
3—The incandescent carbon filament in a vacuum.

4—The incandescent rare oxide filament in air.

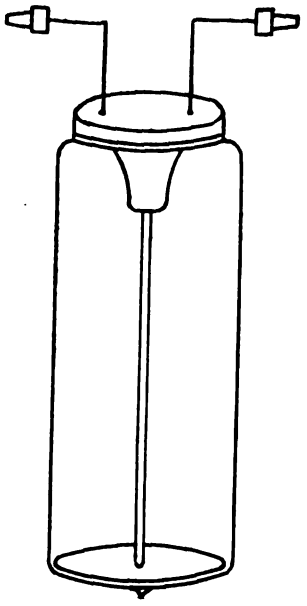
5—The incandescent metal vapor lamp in tube form.

6—The heatless vacuum tube lamp.

In all of these devices, while the ultimate object was the production of light, the ways of attaining this purpose were devious. If the statement is not regarded as too sweeping in character, the fact that all methods of lighting are simply efforts to impress a certain amount of energy upon a light-giving medium or screen will meet every case. From this standpoint, it is evident that the material of which the screen or medium is composed, will have a great influence upon the resulting efficiency. If the screen or medium expresses a condition such that the temperature is limited, then the amount of energy ordinarily absorbed to reach a good light-giving temperature is wasted, in that the resulting temperature does not yield much light. On the other hand, if the medium can stand a very high temperature, then the comparatively large amount of light thrown off, is due to but a slight addition to the energy producing less light. The rare oxide lamp enjoys this reputation, namely, as being a lamp in which a higher temperature yields a much greater amount of light with practically no more energy than that consumed in lower temperature lamps. Dispensing altogether with filaments, and utilizing a gas or vapor, the mercury vapor lamp appears as a logical sequence to previous experiments. It employs a screen of incandescent metallic vapor instead of a solid medium to give light. The so-called vacuum tube lamp is a similar instance of where a screen is employed, composed of comparatively few air particles in a vacuum; the striking and rebound of these, under the influence of electrification, causes incandescence without heat of any importance. Here, it is evident, that the screen upon which the energy operates, is one in which the endeavor is made to avoid the intermediate step in light-making, namely, the temperature.



Automatic Device for Starting the Heater.



Fine Iron Wire Ballast.

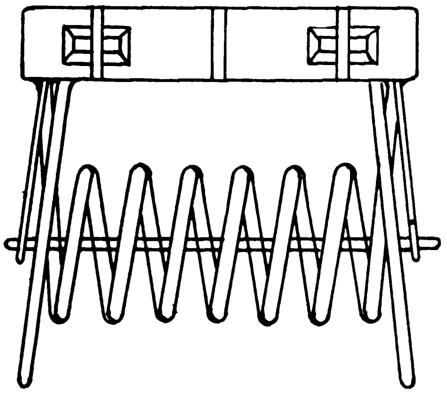
Glower Lamps.—Nernst is credited with the invention of the first practical rare oxide high-temperature lamp. It simply consists of a rod of badly conducting rare oxide material, made up in the form of a paste originally, and then forced through a die to give it its shape. This is called the glower and is supplied with platinum terminals to make contact with the circuit. The rare oxide rod is non-conducting when cold and, in consequence, must be heated before it can conduct current and give light. For this reason it became necessary to contrive a heater for the lamp. The heater is made to work automatically when the light is turned on. Because these physical conditions tend to increase the conductivity of the glower with an increase in temperature, the use of resistance is necessary. Resistances of this kind are of iron, protected from the air in hydrogen-filled bulbs. They are given the name of ballast or ballast resistances. The constituents of the glower lamp when enumerated consist of the following:

1. The rare oxide rod or glower which gives the light at a high temperature.
2. The heater for raising the temperature of the rod when it is to take current.
3. The automatic cut-out for the heater after it has done its work.
4. The iron wire ballast contained in

a tube of gas which regulates the amount of current.

The hydrogen gas employed in the ballast bulb is a more rapid conductor of heat than other gases whose use seems possible.

These lamps are made to fit an incandescent lamp socket and are made up as follows: The smaller lamps are composed of only one glower; the larger lamps consist of six glowers, and may be hung up for illuminative purposes the same as any other large lamp. The ballast resistance is simply connected in series with the glower. The resistance of both the ballast and glower assume a certain value when the lamp is burning. This value limits the current to just the amount necessary to permit it to give its full quota of light. The standard makes of Nernst lamps possess a glower which takes about 220 volts, is 1 inch in length and about $\frac{1}{40}$ of an inch in diameter. The temperature at which the light is given varies from 1,200 degs. F. to 1,400 degs. F., depending upon the current. A fair average is 1,300 degs. F., at which temperature the normal light appears.



A Single Glower and Heating Spiral.

The candle power tests give results as follows: A two-glower, 220-volt lamp gave about 70 cp. with a watt consumption of about 170, or about 2.5 watts per candle power. The light given out during the life of the lamp is very white and agreeable to the eyes when passed through said blasted globes.

The glower lamp needs no vacuum, for the obvious reason that the filament cannot consume in the air. But if inclosed in a vacuum, then the absence of air means a higher temperature and a lower resistance. In consequence, more ballast is required to cut down the current, so the efficiency is not advanced to any remarkable extent by this method. As far as the general power consumption per candle power is concerned, the carbon filament as compared with the filament of Nernst, thought by some to be made of thoria, is about one-half as efficient. The entire gain, as previously stated, is due to a high temperature, by means of which the medium produces more light rays.

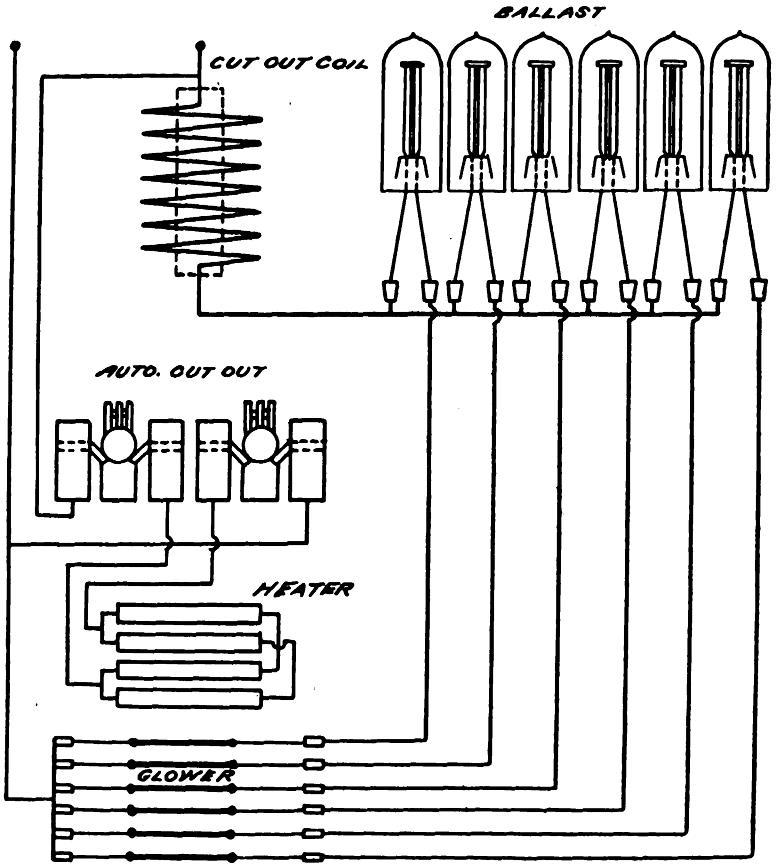


Diagram of Connections of a Six Glower Lamp.

Comparison of Other Light Sources.—The physical effect of light is, of course, that felt by the eye. The principal sources of light, beginning with the sun, which is the most intense light known, are grouped as follows:

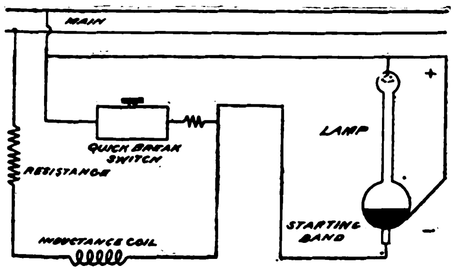
Source of Light.	Approximate Candle Power per Unit Area.	
	Per sq. in.	Per sq. ft.
Sun at noon........	500,000	72,000,000
Arc lamp..........	100,000	14,400,000
Oxyhydrogen light.	5,000	720,000
Nernst lamp.......	1,000	144,000
Incandescent lamp..	300	43,200
Acetylene lamp....	100	14,400
Welsbach lamp....	25	3,600
Gas lamp..........	10	1,400
Kerosene lamp.....	8	1,152
Candle........	4	576

The figures thus given, while not absolutely correct, are still a fair average of the correct candle powers. Experiments conducted with a screen of white material and lamps of the character given produce curious results. The oxyhydrogen light, placed on the screen beside the light from an arc lamp, appears a dull yellow color. In the same manner the acetylene flame sends out a poor kind of light when thus compared. The arc light, when projected on the screen, appears dull in comparison with intense sunlight. The eye is not the most reliable means of comparison, however, because it readily tires and thus fails as a critic. The absorbing qualities of differently colored materials, with regard to light, might be compared with the action of absorbent bodies of various degrees of porosity. White paper, for instance, throws off nearly all the light falling upon it, whereas dark material, such as black paper or black velvet, for instance, absorbs nearly all the light received. The table covering this situation would appear as follows:

Kind of material.	Percentage of light absorbed.	Percentage of light cast off.
White paper......	18	82
Yellow paper.....	40	60
Pink paper.......	64	36
Blue paper........	75	25
Red paper........	88	12
Dark green paper.	88	12
Black paper.......	95	5

The subject of optics and light mixtures occupies an important place in the consideration of commercial light sources. The reason for this is found in the refusal on the part of the public to endure light that is not pleasant to the eyes and senses. In other words, the nervous system is responsive to the effects of certain forms of light, such forms, for instance, where the preponderance of certain light waves over others is productive of unusual color relationships.

The Mercury Vapor Lamp.—In this lamp the red ray is not present when it operates and in consequence the color relationship to which the eye is accustomed is missing. The lamp invented by Cooper Hewitt, bearing the title of the mercury vapor lamp, as its name implies, makes use of the incandescent vapor of mercury for its illumination. A long glass tube is exhausted of air and an electrode attached to one end. This electrode, which may be either iron or mercury, transfers the electrical energy to the other lower electrode at the bottom of the tube composed entirely of mercury. The lamp is thus something like a gigantic thermometer with an upper electrode. The action begins when the circuit is established by means of mercury vapor. In practice this is accomplished by means of a high tension spark, which jumps between the electrodes. To obtain this spark it is necessary to provide a powerful inductance coil, by means of which a quick break sends the spark across.



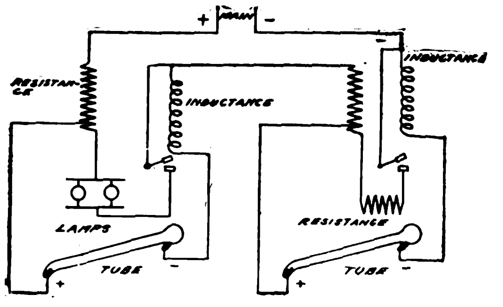
Connections with the Quick-Break Method.

Another way of starting the tube is to tilt it until the mercury forms a stream from electrode to electrode and then permit it to resume its original position. Sufficient incandescent vapor will form to bridge the two electrodes and form the light-giving screen required. The use of direct current has imposed some limitations upon its general application, but that does not otherwise interfere with its increasing field of serviceability. The tube data may be stated as follows:

1. Length of the tube—43 inches for 100 volts, 49 inches for 120 volts.
2. Total length—50 inches for 100 volts, 56 inches for 120 volts.
3. Diameter—1 inch.
4. Current from 3 to 3.5 amperes.
5. Candle power between 650 and 750.
6. Life about 1,600 hours.

Method of Starting and Connecting Up.—The practical facts in connection with this new source of illumination necessarily relate to its installation and connection to the electric light mains.

In the sketches the following conditions are imposed: First, the lamp is started by the inductive device for throwing a spark from electrode to electrode; second, the two lower voltage lamps are set into operation by tipping and are shown in series on a 110 volt circuit.



Two Tubes in Series on a 110-volt Circuit.

The use of the quick break switch, in conjunction with the self-induction coil, is illustrated readily in practice by starting an arc between two carbon rods by means of the electromagnetic discharge of a coil across terminals composed of such carbon rods.

Here with the mercury lamp the high resistance path is bridged readily by means of mercurial vapor and it is then a simple matter to understand the continuation of the phenomenon. The entire principle is that of continuing an arc of mercury between two terminals in a vacuum. The starting circuit is not in use after the arc starts within the tube.

Efficiency of Tube.—The amount of candle power produced equals 750 and the power consumed equals about 400 watts.

On this basis the watt consumption per candle power equals 750 ÷ 400 = 1.875 cp. per watt or conversely, a little more than $\frac{1}{2}$ a watt per candle power. The incandescent lamp does not show figures as high as this, neither does the Nernst lamp. The presence of red rays would mean the universal application of this device wherever electric lighting is done. Their absence limits its use to docks, large lofts, factories and places where the color problem plays no part of importance. The suggestion once advanced that the tube be made of red glass to supply the missing rays, would mean darkness instead of light. As there are no red rays in the light, and as none but red rays can pass through red glass, it is obvious that no light would penetrate the walls of the tube. The only remedy is to provide a means of developing red rays in the tube itself by the introduction of another element or a modification of the method.

Vacuum Tube Lighting.—Exhausted tubes supplied with electrodes, and a high tension alternating current developing light within them, represent the elements of this system. The current is unique, inthat it is developed into a wave with a peculiar form of curve. In this method of light-making, a certain abrupt influence is necessary in the transformer to develop the correct inductance and consequent discharge through the tube. The peaked nature of the wave, passing in and out of the step-up transformer, is thus a characteristic of the system. The energy passes through many feet of tube in producing light. As far as scientific ideals are concerned this method comes first, but it has not as yet touched that high apex of efficiency necessary to give it prominence or popularity.

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THE BRITISH ASSOCIATION.

Prof. Darwin on Radium and the Constitution of Matter.

The presidential address of Prof. G. H. Darwin, F.R.S., to the British Association for the Advancement of Science being divided into two parts—the second of which was not due to be delivered at Johannesburg until August 30—we are only able to refer to the first half which was delivered at Cape Town on August 15. Evolution was the theme, and radium, atomic theory and the constitution of matter occupied considerable attention. We quote the following extracts:

The fascinating idea that matter of all kinds has a common substratum is of remote antiquity. In the Middle Ages the alchemists, inspired by this idea, conceived the possibility of transforming the baser metals into gold. The sole difficulty seemed to them the discovery of an appropriate series of chemical operations. We now know that they were always indefinitely far from the goal of their search, yet we must accord to them the honor of having been the pioneers of modern chemistry. The object of alchemy as stated in modern language was to break up or dissociate the atoms of one chemical element into its component parts, and afterwards to reunite them into atoms of gold. Although even the dissociative stage of the alchemistic problem still lies far beyond the power of the chemist, yet modern researches seem to furnish a sufficiently clear idea of the structure of atoms to enable us to see what would have to be done to effect a transformation of elements. Indeed, in the complex changes which are found to occur spontaneously in uranium, radium, and the allied metals we are probably watching a spontaneous dissociation and transmutation of elements. Natural selection may seem, at first sight, as remote as the poles asunder from the ideas of the alchemist, yet dissociation and transmutation depend upon instability and regained stability of the atom, and the survival of the stable atom depends on the principle of natural selection. Until some 10 years ago the essential diversity of the chemical elements was accepted by the chemist as an ultimate fact, and, indeed, the very name of atom, or that which cannot be cut, was given to what was supposed to be the final indivisible portion of matter. The chemist thus proceeded in much the same way as the biologist who, in discussing evolution, accepts the species as his working unit. Accordingly, until recently the chemist discussed working models of matter of atomic structure, and the vast edifice of modern chemistry has been built with atomic bricks.

But within the last few years the electrical researches of Lenard, Roentgen, Becquerel, the Curies, of my colleagues Larmor and Thomson, and a host of others, have shown that the atom is not indivisible, and a flood of light has been thrown thereby on the ultimate constitution of matter. Amongst all these fertile investigators it seems to me that Thomson stands pre-eminent, because it is principally through him that we are to-day in a better position for picturing the structure of an atom than was ever the case before. Even if I had the knowledge requisite for a complete exposition of these investigations, the limits of time would compel me to confine myself to those parts of the subject which bear on the constitution and origin of the elements. It has been shown, then, that the atom, previously supposed to be indivisible, really consists of a large number of component parts. By various convergent lines of experiment it has been proved that the simplest of all atoms—namely, that of hydrogen—consists of about 800 separate parts, while the number of parts in the atom of the denser metals must be counted by tens of thousands. These separate parts of the atom have been called corpuscles or electrons, and may be described as particles of negative electricity. It is paradoxical, yet true, that the physicist knows more about these ultra-atomic corpuscles and can more easily count them than is the case with the atoms of which they form the parts. The corpuscles, being negatively electrified, repel one another just as the hairs on a person's head mutually repel one another when combed with a vulcanite comb. The mechanism is as yet obscure whereby the mutual repulsion of the negative corpuscles is restrained from breaking up the atom, but a positive electrical charge or something equivalent thereto, must exist in the atom so as to prevent disruption. The existence in the atom of this community of negative corpuscles is certain, and we know further that they are moving with speeds which may in some cases be comparable to the velocity of light, namely, 200,000 miles a second. But the mechanism whereby they are held together in a group is hypothetical.

It is only just a year ago that Thomson suggested, as representing the atom, a mechanical or electrical model whose properties could be accurately examined by mathematical methods. He would be the first to admit that his model is at most merely a crude representation of actuality, yet he has been able to show that such an atom must possess mechanical and electrical properties which stimulate, with what Whetham describes as "almost Satanic exactness," some of the most obscure and yet most fundamental properties of the chemical elements. "Se non e vero, e ben trovato," and we are surely justified in believing that we have the clue which the alchemists sought in vain. Thomson's atom consists of a globe charged with positive electricity, inside which there are some thousands of corpuscles of negative electricity, revolving in regular orbits with great velocities. Since two electrical charges repel one another if they are of the same kind, and attract one another if they are of opposite kinds, the corpuscles mutually repel one another; but all are attracted by the globe containing them. The forces called into play by these electrical interactions are clearly very complicated, and you will not be surprised to learn that Thomson found himself compelled to limit his detailed examination of the model atom to one containing about 70 corpuscles. It is indeed a triumph of mathematical power to have determined the mechanical conditions of such a miniature planetary system as I have described.

It appears that there are definite arrangements of the orbits in which the corpuscles must revolve if they are to be persistent or stable in their motions. For the purpose of general discussion, which is all that I shall attempt, you may take it that the number of corpuscles in such a community is fixed; and we may state that definite numbers of corpuscles are capable of association in stable communities of definite types. An infinite number of communities are possible, possessing greater or lesser degrees of stability. Thus the corpuscles in one such community might make thousands of revolutions in their orbits before instability declared itself; such an atom might perhaps last for a long time as estimated in millionths of seconds, but it must finally break up, and the corpuscles must disperse or rearrange themselves after the ejection of some of their number. We are thus led to conjecture that the several chemical elements represent those different kinds of communities of corpuscles which have proved by their stability to be successful in the struggle for life. If this is so, it is almost impossible to believe that the successful species have existed for all time, and we must hold that they originated under conditions about which I must forbear to follow Sir Norman Lockyer in speculating. But if the elements were not eternal in the past, we must ask whether there is reason to believe that they will be eternal in the future. Now, although the conception of the decay of an element and its spontaneous transmutation into another element would have seemed absolutely repugnant to the chemist until recently, yet analogy with other moving systems seems to suggest that the elements are not eternal.

At any rate it is of interest to pursue to its end the history of the model atom which has proved to be so successful in imitating the properties of matter. The laws which govern electricity in motion indicate that such an atom must be radiating or losing energy, and therefore a time must come when it will run down as a clock does. When this time comes it will spontaneously transmute itself into an element which needs less energy than was required in the former state. Thomson conceives that an atom might be constructed after his model so that its decay should be very slow. It might, he thinks, be made to run for a million years, but it would not be eternal. Such a conclusion is an absolute contradiction to all that was known of the elements until recently, for no symptoms of decay are perceived and the elements existing in the solar system must already have lasted for millions of years. Nevertheless, there is good reason to believe that in radium, and in other elements possessing very complex atoms, we do actually observe that break-up and spontaneous rearrangement which constitute a transmutation of elements. It is impossible as yet to say how science will solve this difficulty, but future discovery in this field must surely prove deeply interesting. It may well be that the train of thought which I have sketched will ultimately profoundly affect the material side of human life, however remote it may now seem from our experiences of daily life.

I have not as yet made any attempt to

represent the excessive minuteness of the corpuscles, of whose existence we are now so confident, but, as an introduction to what I have to speak of next, it is necessary to do so. To obtain any adequate conception of their size we must betake ourself to a scheme of threefold magnification. Lord Kelvin has shown that if a drop of water were magnified to the size of the earth the molecules of water would be of a size intermediate between that of a cricket ball and of a marble. Now, each molecule contains three atoms, two being of hydrogen and one of oxygen. The molecular system probably presents some sort of analogy with that of a triple star; the three atoms, replacing the stars, revolving about one another in some sort of dance which cannot be exactly described. I doubt whether it is possible to say how large a part of the space occupied by the whole molecule is occupied by the atoms, but perhaps the atoms bear to the molecule some such relationship as the molecule to the drop of water referred to. Finally, the corpuscles may stand to the atom in a similar scale of magnitude. Accordingly a threefold magnification would be needed to bring these ultimate parts of the atom within the range of our ordinary scales of measurement. I have already considered what would be observed under the triply powerful microscope, and must now return to the intermediate stage of magnification in which we consider those communities of atoms which form molecules. This is the field of research of the chemist.

Although prudence would tell me that it would be wiser not to speak of a subject of which I know so little, yet I cannot refrain from saying a few words. The community of atoms in water has been compared with a triple star, but there are others known to the chemist in which the atoms are to be counted by fifties and hundreds, so that they resemble constellations. I conceive that here again we meet with conditions similar to those which we have supposed to exist in the atom. Communities of atoms are called chemical combinations, and we know that they possess every degree of stability. The existence of some is so precarious that the chemist in his laboratory can barely retain them for a moment: others are so stubborn that he can barely break them up. In this case dissociation and reunion into new forms of communities are in incessant and spontaneous progress throughout the world. The more persistent or more stable combinations succeed in their struggle for life, and are found in vast quantities, as in the cases of common salt and of the combinations of silicon. But no one has ever found a mine of gun-cotton, because it has so slight a power of resistance. If, through some accidental collocation of elements, a single molecule of gun-cotton were formed, it would have but a short life. Stabilitity is, further, a property of relationship to surrounding conditions; it denotes adaptation to environment. Thus salt is adapted to the struggle for existence on the earth, but it cannot withstand the severer conditions which exist in the sun.

The second part of the address will be devoted to a consideration of various theories of evolution in the heavens.

WRINKLES.*

EDITED BY H. C. ABELL.

Making a Pump Lift Hot Water.

Hot water, even up to 180 degs. F., may be lifted about 10 or 11 feet if the following piping is run: At the point where the vertical riser from the well meets the horizontal suction pipe to the pump an elbow would ordinarily be used; instead of the elbow use a tee, on the run of the tee extend the vertical pipe for about four feet and cap it over. This will do the trick.

H. C. HALL, Fall River, Mass.

An Indicator Device.

Where considerable work is done in indicating engines in isolated plants, etc., a guide, partly for the indicator card, made as follows, will be found useful:

A clamp to fit the indicator piping is mounted on the end of a piece of half-inch pipe 24 inches long; a small pulley is mounted on a block that slides on the pipe and is fastened with a set screw. This can be quickly fastened to the indicator piping, which is necessarily on the cylinder, and for any position of the reducing motion the card can be adjusted so that it is in line with the cylinder.

J. F. DOSTAL, Denver, Col.

Old-Time Telegraphers Meet.

The Old-Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps are holding their annual conventions in New York City together this week. The exercises commenced yesterday and will continue until Friday.

The programme to-day includes a trip to Coney Island, while on Thursday the banquet will take place at the Waldorf-Astoria, when, it is expected, that at least 500 to 700 will participate. Friday will be devoted to automobile rides and then the convention will adjourn.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 22, 1905.

Electric Railways and Appliances.

797,589. Electric Car or Locomotive. Nils D. Levin, Chicago, Ill., assignor to the Goodman Manufacturing Company, same place. Filed April 22, 1904. Renewed April 6, 1905.

797,591. Electrical Railway Signaling System. Leonidas N. Lyon, Jr., Flatonia, Tex. Filed Nov. 29, 1904.

797,669. Trolley-Wire-Repair Service. Hermann Dems, Chicago, Ill. Filed Nov. 11, 1904.

797,678. Electric Railway-Signal. Jake Friedlander, Fargo, N. D. Filed Dec. 27, 1904.

797,720. Trolley. Henry B. Clarke, Chicago, Ill. Filed Feb. 26, 1904.

797,859-860. Train-Control System. Charles E. Lord, Cincinnati, O., assignor to the General Electric Company. Filed Jan. 27, 1905.

Electric Lights and Appliances.

797,593. Incandescent Electric Lamp. Albert W. W. Miller, South Orange, N. J. Filed Sept. 3, 1903.

797,629. Electric-Arc Lamp. Bernard A. Stowe, Cleveland, O., assignor to the Jandus Electric Company. Filed May 25, 1904.

797,690. Incandescent-Lamp Socket. Norman Marshall, Newton, Mass. Filed Jan. 21, 1904.

797,806. Arc-Lamp Hanger and Cut-Out. Charles E. Harthan, Lynn, Mass., assignor to the General Electric Company. Filed April 29, 1903.

797,825. Electric-Lamp Socket. Albert P. Seymour, Syracuse, N. Y., assignor to Pass & Seymour, Solvay, N. Y. Filed April 27, 1904.

Electrical Machinery and Apparatus.

797,679. Circuit-Closer, Jake Friedlander, Fargo, N. D. Filed March 20, 1905.

797,774. System of Motor-Control. Charles E. Lord, Cincinnati, O., asssignor to the General Electric Company. Filed April 12, 1905.

797,868. Transformer. Edwin W. Rice, Jr., Schenectady, N. Y., assignor to the General Electric Company. Filed April 4, 1904.

797,889. Controlling Electric Motors. William Geipel and Frederick M. T. Lange, London, and George W. Mascord, Barnes, Eng. Filed Nov. 28, 1904.,

797,917. Electrical Meter. Henry W. Sayles, Peoria, Ill., assignor to the Diamond Meter Company, same place. Filed March 13, 1905.

797,993. Automatic Regulator for Electric Circuits. Montgomery Waddell, New York City. Filed June 28, 1904.

798,038-039. Apparatus for Electrical Regulation. Albert S. Hubbard, Greenwich, Conn. Filed June 17, 1904, and Feb. 25, 1905.

798,052. Steering Mechanism for Motor-Vehicles. Herbert W. Alden, Hartford, Conn., assignor to the Electric Vehicle Company. Original application filed June 16, 1902. Divided and this application filed June 19, 1905.

Telephones and Telephone Apparatus

797,561. Telephone Hook-Switch. Josephus M. Clement, Mineralbluff, Ga. Filed March 8, 1905.

797,586. Telephone System. Edmund Land, Grand Rapids, Mich. Filed Nov. 2, 1904.

798,035. Telephone System. Calvin R. Green and David R. Green, Risingsun, Ind. Filed Dec. 20, 1904.

798,043. Automatic Listening Apparatus for Telephone Operators' Cord-Circuits. Jacob W. Lattig, Wyncote and Charles L. Goodrum, Philadelphia, Pa., assignors to the Eastern Telephone Manufacturing Company, West Chester, Pa. Filed June 6, 1903.

Miscellaneous.

797,570 Multiplex-Telegraph System. Tullio Giara, Boston, Mass. Filed July 5, 1904.

797,628. Electromagnetic Compensating Device. Bernard A. Stowe, Cleveland, O., assignor to the Jandus Electric Company. Filed May 24, 1904.

797,718. Portable X-Ray Apparatus. Eugene W. Caldwell, New York City. Filed Aug. 18, 1904.

797,747. Electric Furnace. Henry N. Potter, New Rochelle, N. Y., assignor to George Westinghouse, Pittsburg. Pa.. Filed July 23, 1903.

797,811. Watch Demagnetizer. Patrick Kerns, Chicago, Ill. Filed March 7, 1903.

797,863. Syntonic Signaling System. Maurice Milch, Schenectady, N. Y., assignor to the General Electric Company. Filed March 30, 1904.

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*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs. Col., June 6-11 1905.

THE TELEPHONE WORLD.

Telephone Company Wins.

An option by Judge C. D. Clark, in the suit styled the East Tennessee Telephone Company vs. the Mayor and Aldermen of the City of Knoxville, has been made public, and every claim made by the plaintiff is sustained.

Some time ago the board of public works of Knoxville interfered with the telephone company in its erection of poles and other work necessary for the operation of an exchange in that city. The corporation asked an injunction to prevent the city from interfering with its work.

City Attorney Culton filed a demurrer in which he alleged that the corporation had no franchise in that city because of a technicality. Briefs were filed and after due consideration Judge Clark forwarded his decision to Knoxville, in which the injunction is granted. He holds that the corporation holds a good and valid franchise, and even if such were not true, the city, by granting privileges to the company in the past and regarding it as a lawful corporation, has estopped itself from interference.

Oakland, Cal., has a new Independent automatic telephone system in operation, at least a considerable portion of the work of installing such a plant has already been done. About two years ago W. A. Beasley obtained a franchise for the establishment of an Independent telephone system in Oakland. This franchise was subsequently transferred to the Oakland Home Telephone Company, which was organized for the purpose of building the system. The company's plans are to install the automatic system over the whole of Oakland. All of the work will be of first-class character and it is intended the subscribers will all be furnished with telephones as fast as the machinery arrives from the East.

The Rogers Telephone & Electric Company of Danbury, Conn., with a capital stock of $20,000, divided into 200 shares of $100 each and with the whole amount paid in, has been incorporated by Arthur J. Baldwin, of New Jersey; N. Burton Rogers, George L. Eastman, C. B. Bogers and Annie R. Davenport, of Danbury, and Frank E. Wiske, of New York.

The new switchboard and the other improvements to the plant of the Independent Telephone Company of Syracuse, N. Y., will be in operation by January 1,

Theodore Gary, the Macon, Mo., capitalist, who recently purchased the Home telephone system in Independence, expects to start improvements in the newly acquired plant.

News from Philadelphia, Pa., states that under the terms of the Keystone Telephone mortgage the company's conduits cannot be sold, but they may be leased.

There are said to be nearly 50 different rural telephone lines in Crawford County, Kan., owned by farmers.

The Independent Telephone Company of Athens, Ill., has put a telephone in the city hall for the use of the city officials.

Two Telephone Companies Seek Franchises.

Applications for franchises from two Independent telephone corporations, whose financial standing is said to be good, are now pending before the Brooklyn, N. Y., board of estimate, and a public hearing will be held on one of them on September 15. The public hearing on the other application has already been held, and the experts in the finance department are busy determining the terms and compensation.

The latest franchise application on which the public hearing will be held next month is from the Star Telephone Company, a domestic corporation organized under the laws of this State. The city is asked to give the company a franchise to lay, erect, construct and maintain suitable wires or conductors, over and under the streets and highways of the entire five boroughs. This privilege is asked for a period of 25 years, with the right of renewal for another 25 years. At the end of this period the franchise and all the property, except the plant of the company, shall revert to the city without further compensation. It is stipulated that the city shall pay a fair valuation for the plant.

Here are the conditions under which the company proposes to operate :

"Five cents a call where there is no guarantee by the subscriber to pay a fixed sum per annum.

"Sixty dollars per annum for unlimited service when the instrument is located in a private residence.

"One hundred dollars per annum for unlimited service where the telephone instrument is located in a place of business."

In payment for the franchise the company agrees to furnish and install in the various municipal offices for the free use of the city telephones to a number not to exceed 600. It also agrees to pay to the city each year a sum equal to 5 per cent. of the gross receipts of the company. Work to install the system on the granting of the franchise is to begin immediately. The application is signed by Richard S. White as president.

After the public hearing, which is a charter formality to give any person interested an opportunity to be heard, the application will be referred to the bureau of franchises in the finance department, to arrange the terms and compensation.

The Bureau at present is preparing the terms and compensation of a franchise which will be granted to the Atlantic Telephone Company some time in the fall. The rates for which this company is ready to give the city a public telephone service are; it is said, just as advantageous as those offered by the Star Telephone Company.

The Northwestern Telephone Company of Minneapolis, Minn., is about to put in a private exchange in the court house, following in the footsteps of the Twin City Company, which has long maintained a court house central. The location has not yet been decided upon, but plans for the exchange are being drawn up.

The North Cape Telephone Company has extended another line to Ives Grove, Wis.

Final survey on the extension of the Southwestern Telephone Company from Corpus Christi to Rockport, Tex., was lately completed. Workmen have staked a line from the former place to San Diego, in Duval County. This will give Corpus Christi two circuits along the line of the Texas-Mexican Railroad. All these improvements are under the supervision of Engineer W. C. Prickett. Plans and specifications are now being considered for changing the Corpus Christi exchange to a central energy system. Within the past year the number of subscribers in that city has almost doubled, owing to Manager Truitt and improved business conditions. There remain many orders ahead for new 'phones, which will be supplied as soon as possible.

A meeting was recently held at the court house in Logan, Ia., by those interested in reducing local telephone rates and the formation of a new Independent mutual company. About 200 were in attendance. The communication from the Woodbine Telephone Company was read and a number of speeches were made. A committee, composed of B. A. Keller, John A. Berry, S. N. Dale, J. M. Kennedy and W. E. Elbert, was chosen to go to Woodbine in regard to the matter.

The Home Telephone Company of Bowling Green, Ky., has just completed the task of putting in about two miles of cable in that city. It has also made a number of extensions in different parts of the city and county and greatly increased the capacity of the plant. This company is daily adding to its already fine service and the people of the city are greatly pleased with the effort being put forth by the management to give the people a first-class telephone system,

The Oceanside, Cal., Home Telephone & Telegraph Company has filed a petition with the city for a 50-year franchise, work on the lines to begin at once and lines to be put in working order within 18 months. Sixty days will see the lines through Oceanside to San Diego. The city council will without doubt grant the desired franchise.

Officers have been elected by the Citizens' Standard Telephone Company of Kingston, N. Y., as follows: Mortimer C. Drake, president; Thomas M. Brush, vice-president; Charles Reynolds, secretary and treasurer.

The Browerville, Minn., Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $10,000.

Telephone Incorporations.

The Adjustaphone Company, Camden, N. J. —to manufacture telephones, switchboards, transmitters and machinery. Capital stock, $250,000. Incorporators: Robert Hill, William S. Pearne, and Frank D. Pearne.

The Effingham County Telephone Company, Altamont, Ill. Capital stock, $6,000. Incorporators: C. E. Munday, A. B. Munday and G. F. Taylor.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Benwood, W. Va.—The Ohio Valley Electric Light & Power Company has been organized with W. C. Handlan, president.

Camden, Pa.—The object of the Wyoming Gas & Electric Company is to operate and maintain gas and electric lighting plants. Its capital stock is $15,000. John A. MacPeak and others are interested.

Chicago, Ill.—The Austin Electric Light Company of this city has been incorporated with a capital stock of $10,000, for the purpose of furnishing light, heat and power. The incorporators are Charles R. Whitman, George E. Dawson and others.

Clinton, O.—The Clinton Electrical Light & Power Company has been incorporated with a capital of $10,000, by William L. Morey and J. W Robb.

Columbia, Mo.—In a recent special election the citizens voted to issue $10,000 worth of bonds for the extension of the sewer system. A $10,000 issue was also authorized for the construction of improvements to the water and electric light plant, which has been owned by the city for two years. This issue is in addition to a $100,000 issue at the time the plant was bought.

Cooperstown, N. D.—An electric light franchise is to be granted here.

Concord, N. C.—This city is soon to have practically a new electric light plant. Contracts for the necessary materials have already been let and bids for the machinery will soon be asked for.

Dana, Ind.—The citizens have decided by popular vote to erect an electric light plant.

Enosburg Falls, Vt.—F. W. Sayles, of Boston, is preparing plans for an electric light plant which is to be built by the D. B. J. Kendall Company.

Fairmont, Minn.—The citizens will vote on the question of issuing $18,000 in bonds to enlarge, extend and improve the electric light plant.

Gainesville, Fla.—This city will order an election to vote on issuing bonds for $50,000 to construct a sewerage system; $50,000 for buying the present electric plant, or building a new one, and $10,000 for street improvements. Address the mayor.

Geneva, Ind.—W. R. Thurston, of Bern, who was instrumental in installing the electric light plant at that place, has asked the town board here to grant him a franchise permitting him to build an electric light plant.

Glasford, Ill.—This city is to have an electric light plant.

Latrobe, Pa.—The Latrobe Electric Light Company has purchased the plant of the Derry Electric Light Company. It is stated that the intention is to supply the current for the Westmoreland County Street Railway. Latrobe, Derry, Bradenville, Loyalhanna and other intermediate points, will be furnished with electric light from the plant here.

Mattapoisett, Mass.—Present indications point to a successful consummation of plans that have been underway for the past two years to furnish this place with electric lights for the general use of the residents. An examination made by the New Bedford Gas & Edison Light Company two years ago demonstrated that the plan was a feasible one, if a sufficient number of the residents of the town would agree to use electricity. It is believed now that the agitation has reached a point where it will be carried out.

Pekin, Ill.—The Tremont electric light and power plant will be rebuilt.

Pentwater, Mich.—The Pere Marquette Power & Light Company here has been granted a 10-year contract for furnishing the village of Hart with power and light. The company will build a power house on Ruby Creek, and furnish light and power to this place, Hart and Shelby.

San Francisco, Cal.—It is stated upon the highest authority that the actual transfer of the San Francisco Gas & Electric Company to the Rockefeller interests has taken place.

Sumner, Ia.—Ground has been broken for the erection of the electric light plant.

Toledo, O.—The Toledo Gas, Electric & Heating Company, the concern that recently merged the heating and lighting companies of this city, has decided on the location for a new lighting plant. Willard F. Robinson is president of the new company.

STREET RAILWAYS.

Albany, N. Y.—The Genesee River Railroad Company of New York was lately incorporated to build and operate a steam or electric road 34 miles long from Portage to Cuba. The capital is $250,000 and the directors are Frederick B. Underwood, George F. Brownell, Francis L. Stetson, Granville A. Richardson, Charles Steele, Joseph M. Graham, M. P. Blauvelt and J. C. Stuart, of New York, and Herbert A. Taylor, of Upper Montclair, N. J.

Angola, Ind.—An election will shortly be held to vote $35,000 for the St. Joe Valley Traction Company.

Bessemer, Ala.—There is considerable talk in Jonesboro with reference to an electric car line, it being understood that the Birmingham Railway, Light & Power Company is making a move to extend its lines from Jonesboro to this city.

Boonville, Ind.—A franchise has been granted to the Evansville & Newburg Traction Company into this city to the public square.

Defiance, O.—A movement is on foot for the construction of an electric line between this city and Detroit.

Flushing, N. Y.—A. T. Stewart's old railroad line, running from here to Garden City, is to be rebuilt by the Long Island Railroad Company and made part of its electrical system.

Hutchinson, Kan.—Howard S. Lewis has completed a deal whereby he acquired the L. A. Bigger interests in the Hutchinson Street Railway Company. The purchase was made for a syndicate, of which Mr. Lewis is the head, and which has for its object the transforming of the system into an electric railway system. The organization of the company and the securing of all necessary concessions will be carried out at once.

Lake George, N. Y.—The Ticonderoga Union Terminal Railroad Company has been incorporated to operate an extensive line of railways in the Eastern Adirondacks. The contract for construction between Addison Junction, the termini of the Rutland division and New York Central and the Delaware & Hudson Company to this place, it is expected will soon be let to a construction company and that work will begin inside of 60 days.

Maysville, Ky.—The Maysville-Flemingsburg Motor Traction Company, with $12,000 capital stock, has been incorporated.

Monee, Ill.—The Chicago & Southern Traction Company has a force of men at work surveying for the electric line from Chicago Heights to this place, and from here to Kankakee.

Orange, N. J.—Workmen have started to change the grade and gauge of the old Orange Mountain Traction Company's cable road, which scales the Orange Mountain in West Orange. It is now proposed to run a trolley line over the old roadbed. The road will open a large tract of valuable and at present undeveloped country.

Paxton, Ill.—The McKinley Syndicate will build an electric line from Danville to Newman.

Piercetown, S. C.—A meeting was held here recently for the purpose of discussing plans for building the proposed trolley line between Easley and Anderson.

Pontiac, Ill.—The stockholders of the Bloomington & Pontiac Electric Railway, at a meeting held here, authorized an increase in the capital stock from $300,000 to $2,500,000. Work on extending and equipping the road from this city to Bloomington and from Dwight to Joliet will be commenced at an early day.

Pottsville, Pa.—The Pottsville Union Traction Company has issued orders for the construction at once of a trolley line between Frackville and St. Clair. It will be six miles in length and connect with the 40 miles of trolley system in and abont the county seat.

Wooster, O.—The entire issue of $800,000 of bonds for constructing the Wooster & Mansfield Electric Railway have been sold.

POWER PLANTS.

Galion, O.—The council has at last granted a franchise to the Crawford County Gas & Electric Company. The company will construct a plant here and furnish electric power throughout the county.

Pittsfield, Mass.—Plans are under way for the erection of a big electrical power plant on the Deerfield River, a few miles north of the eastern portal of the Hoosac Tunnel, to generate 4,000 hp. A charter for the new company has been secured from the State of Vermont, under the name of the Deerfield River Power Plant Company. Among those interested in the project are W. S. Morton, of Hartford, Conn.; James H. Roraback, of Canaan, Conn., and Faxon Bowen, of Readsboro, Vt. The plant will be located near Readsboro, just across the Massachusetts State line, and a few miles north of Hoosac Tunnel station at the eastern portal.

Rhinelander, Wis.—A. E. Edmonds and others of this place, will erect a power plant near Florence, and will also build an interurban line.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 16⅜@16⅝c.; Lake 16⅜@16⅝c.; casting, 16@16¼c.

The annual meeting of the Philadelphia Union Traction Company will be held September 20.

Chicago City Railway stock was sold on Saturday for the first time in several months, the price being 190.

The Edison Electric Illuminating Company of Boston has filed a statement giving $29,000,000 as its valuation.

The Bell Telephone Company of Philadelphia claims that it will earn nearly 10 per cent. this year on its capital stock.

Electric Company of America stock was heavy in Philadelphia on Monday on rumored competition with its Atlantic City company.

Public hearings before the Massachusetts Railroad Commissioners, which were discontinued on July 20 for the vacation period, will be resumed September 5.

The Nahant & Lynn (Mass.) Street Railway Company has petitioned the railroad commissioners for authority to issue $50,000 additional stock for construction purposes.

The Brooklyn Rapid Transit Company's annual report is expected to show about 3 per cent. earned on the stock, with gross earnings in the neighborhood of $16,300,000.

The directors of the Kansas City (Mo.) Railway & Light Company have declared a regular quarterly dividend of 1½ per cent. on the preferred stock, payable September 1.

A mortgage for $15,000,000 was recently filed at Media, Pa., by the Philadelphia & Western Railroad Company. It is said that the new road will be operated by electricity.

A director of the Electric Storage Battery Company says the new storage battery which Thomas A. Edison invented is not causing his company any uneasiness, and the practicability of the new invention is seriously questioned.

The recent strength and relative activity in Consolidated Traction of New Jersey is attributed to the fact that the stock goes on an increased dividend basis next year. This year the guaranteed dividend is 3½ per cent. and next year it will be 4 per cent.

The Tractional Company of New Jersey has been organized as a holding company to take over the properties of the International Traction Company which operates trolley lines in and around Buffalo, N. Y. It is said that the New York Central is back of the new company.

One of the Lewisohns says: "Never in history has refined copper been so legitimately strong as it is to-day. There is no surplus anywhere, and there is practically no spot copper to be had at any price. Copper deliverable next March is selling at 16 cents per pound."

The annual report of the Chicago Union Traction Company for the year ending this month is expected to show an improvement of about 5 or 6 per cent. in the matter of earnings, compared with the same period a year ago. The report will not be ready to submit to the court for about 40 days.

Announcement is made of a merger of 32 gas and electric light and traction companies in eastern Ohio and western Pennsylvania by capitalists headed by Murray Verner of Pittsburg, Governor Herrick and James Parmalee of Cleveland, with a capitalization of $10,000,000. The new company will control 175 miles of traction lines and means the linking of Pittsburg and Cleveland by electric railways.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Aug. 28
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	214½
Manhattan Elevated Railway	166¼
Metropolitan Street Railway	131⅞
Metropolitan Securities	84⅛
Ninth Avenue	197
Third Avenue	129
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	70¾
Brooklyn City Railway	239
New Orleans Railway	34¼
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81¾
Philadelphia Traction	100⅛
Union Traction	60
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	19½
do. do. do. pref	62½
West End Street, com	97½
do. do. do pref	114
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	8½
do. do. pref.	37
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	17
do. pref.	56⅛
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	18
do. do. pref.	24
Westinghouse, com	170
do. pref.	190
General Electric	182¾
Boston.	
Edison Electric Illuminating	256
General Electric	182¾
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	155
National Carbon, com	60¾
do. do. pref.	115½
Philadelphia.	
Electric Company of America	11⅝
Electric Storage Battery, com	85
do. do. do. pref.	85
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	142
Western Telephone Company	17⅛
New England Telephone Company	184¼
New York.	
American Telegraph & Cable Company	190⅛
Commercial Cable Company	210¼
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	179½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	94
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Chicago Subway	82⅝
Otis Elevator Company	62
Standard Underground Cable	..
Twin City Rapid Transit	117

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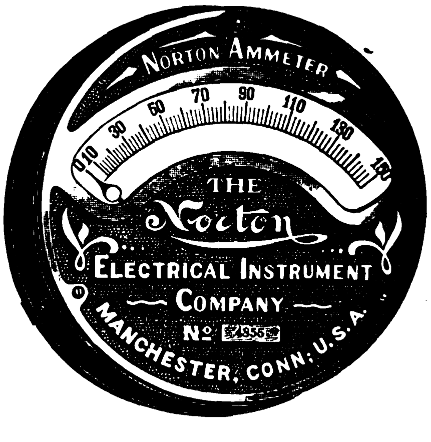
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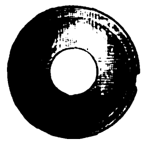

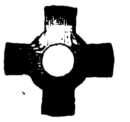

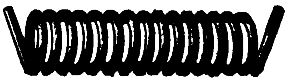

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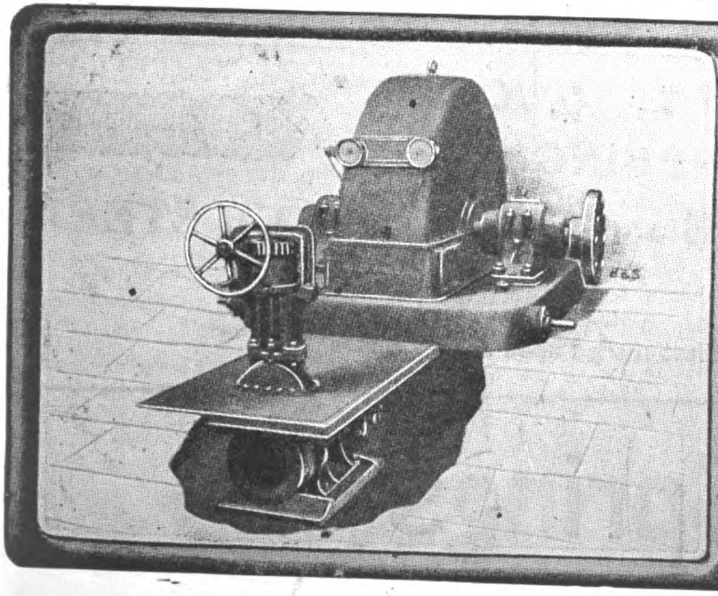

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ELECTRICITY.

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EDITORIAL NOTES.

The Logical Manufacturing Site.

The erection of factories in the near neighborhood of large sources of power has always been regarded as the natural and logical course to follow. These sources of power are even to-day misunderstood, more because of the prevailing custom than through any assumption of theoretical wrong pertaining to such methods. The argument, if any, is one which seeks for a reason for the extraordinary means now employed to develop a factory site far away from the source of fuel or power. In other words, the coal car and the power transmission plant are closely related in this respect, and the relationship is more one which represents a long running bill of expenses than any really legitimate outlay in this class of industrial work. Inherently, the proposition is best understood in relation to a very large factory whose annual power consumption reaches high figures, and whose labor list does not call for such extraordinary talent, that the procuring of it is a difficult or impossible task in a comparatively remote region. But the great coal mines of the United States do not present such flagrant cases of inaccessibility. Quite the contrary is to be witnessed on the ground itself, and the sources of water power are not in any way dissociated from the larger steam roads or thoroughfares.

The logical manufacturing site is one which receives its necessities of fuel and labor where they may be most readily found, not merely where they can be eventually procured. In certain respects, the balance established by industrial enterprises in the fuel and labor problem is not secure. We find electric power going begging for consumers at Niagara and to be had for a low rate. In other sections the labor market is overcrowded and fierce competition results. Seemingly many of our factory sites could bear removal and by so doing simplify this problem wonderfully.

* * *

Epochs as Measured by Radium.

Both geologist and physicist differ in regard to the duration of those epochs which constituted terrestrial time. The evolutionist does not dare to place his life forms as far back as suggested by the geologist. The geologist does not find enough elbow room in the time estimates of the evolutionist to move safely through those great antediluvian periods, when the earth marshalled its chemical forces and a riot of fire and flame preceded the separation of the waters from the land. Keener intellects did not exist than those possessed by the founders of our astronomic ideas. Greater minds cannot be remembered than those whose imagination framed the picture of the cosmic growth. As the years rolled by, and the sages of Egypt and Greece had added all they possessed to the knowledge of the skies, Kant and La Place revived the fading vision and placed it before the thinking world as the Nebular Hypothesis. There we stand, though all the years from Shakespear's time to ours have passed away.

The genius of Newton laid down the universal laws of motion and gravitation, but did not add one single jot to the mystery behind it all. As destiny has so desired it, a woman may be the means by which the highest and greatest triumph of the age will be attained. For it is upon that strange, silent and wonderful pinch of powder obtained by Madame Curie that our greatest hopes are built. It is to radium we look for the answer to the question that agitates the minds of physicist and geologist alike. That gives new hope to the patient astronomer sweeping the wide heavens with his ever observant eye. George Howard Darwin, the son of Charles Darwin, in his address before the British Association states:

"Physicists, from a calculation of the total output of the sun's heat, had regarded it necessary that the whole history of the solar system be comprised within 20,000,000 years. I always believed that the geologists were more nearly correct. Recent marvelous discoveries in physics show that concentration of matter was not the only source from which the sun might draw its heat. Radium was a substance which was, perhaps, millions of times more powerful than dynamite."

It is here that reconciliation is largely assured between the warring forces. Helmholtz believed the contraction of the sun sufficient to reinforce that orb's diminishing temperature. But with the startling facts presented—that radium is always hotter than the surrounding air; that it ceaselessly manifests its extraordinary energy; that it creates from within itself another new element, helium—from these wonderful facts we say a new cosmic process is introduced into the economy of nature. The play and counter-play of electric forces seems to be the new idea, embracing in its scope the tenuous nebula, and awakening within such passive world matter, the power by which it passes through its eternal cycles and transmutes itself into the earth and rocks, the water and wide stretching glades.

* * *

The Advance in Price of Copper.

There is no doubt that a large number of manufacturers believe that the present high price of copper is unnatural and that it should break, but nevertheless the fact is apparent that the largest consumers of refined copper are buying the metal confidently at present prices.

The reselling by Chinese interests of electrolytic at slightly below 16 cents will curtail exports to that center considerably during the present month. The total exports for August amounted to 21,240 tons, of which 2,530 were sent to China. Some persons profess to believe that the demand from China will hereafter be supplied from the Japanese mines, but the cessation of war between Russia and Japan is not expected to materially alter conditions now existing. The copper mines in Japan continued in operation notwithstanding the war, and were not closed as some might suppose from certain statements going the rounds. It is an interesting fact that the production of copper in Japan last year was the largest on record for that country, being returned at 34,850 tons.

A director of the United Metals Selling Company gave out this statement on Saturday: "The sellers of copper have been making an honest effort during the last few weeks to keep copper prices down. A stable market is what is wanted by buyer and seller alike. These efforts, however, have failed. There is practically no spot copper for sale at any price, and you might as well quote electrolytic at 18 cents as at 16¼ cents. We can at present take care of only our best customers. Our people believe that refined copper will average close to 15½ cents all next year."

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The annual convention of the Association of Edison Illuminating Companies will be held at the Hotel Champlain, Clinton County, N. Y., on September 12, 13 and 14.

Chicago to New York by trolley is an innovation promised by William S. Reed, a builder of railroads. Mr. Reed has purchased the Chicago Electric Traction Company and has organized two other companies which will complete the gaps which now bar a continuous ride on electric roads between the cities named.

A series of evening lectures on steam and electrical engineering will be given during the coming fall and winter at the New York Trade School, 1st avenue, 67th and 68th streets. These lectures are intended for practical workers—stationary engineers, firemen, electrical workers and machinists.

The American Electro-Therapeutic Association will hold its next meeting in New York City September 19, 20 and 21. Dr. C. E. Skinner, of New Haven, Conn., is secretary.

Two experts from the Swiss Government have been sent here to study electric railway methods in this country. They are W. Wyssling of Zurich, secretary-general of the Swiss commission for the study of the electric railways and commissioner of the Swiss Government for electric railway studies, and Charles Wirth of Berne, Swiss Government engineer. The significance of their visit is apparent when it is said that the Swiss Government plans to electrify all of the Government lines and to operate these lines from water power plants, utilizing the mountain streams as a source of energy.

In order to detect and localize without loss of time a burnt-out lamp on telephone switchboards, Mix & Genest of Berlin, Germany, have devised a double-filament signal lamp, says the London "Electrician," According to the "Electrotechnische Zeitschrift," one of the filaments is of the ordinary kind, while the second filament (which is in parallel with the first) has a high resistance. As long as the ordinary filament is intact, the auxiliary filament is scarcely noticed. Should the filament proper fail, however, the dull red light of the auxiliary filament will continue to record a call, and will give notice, at the same time, that the ordinary filament has collapsed.

It was announced Monday that two of the big electric locomotives which are expected to be used in dragging trains through the Pennsylvania Railroad's tunnel would be delivered on the Long Island Railroad tracks within a day or two. The locomotives are ponderous 100-ton machines each of 2,400 hp. Before they are accepted for use in the tunnel they will be thoroughly tested on the electrified parts of the Long Island Railroad, where conditions, including the power-rail equipment, are similar to those that will prevail in the tunnel.

Portugese newspapers announce that an important discovery has been made in the province of Traz-os-Montes. A mineral said to contain a large amount of radium has been found there.

An electrically-driven oil boat, 245 feet long, 32 feet beam, and rated at 1,100 tons, has been built for the Russian oil trade, using three Diesel oil engines for the production of power, which is transmitted electrically to motors operating the propellers. The engines are placed amidships and the oil tanks forward and aft. The entire control equipment for the motors is situated in the pilot house.

The Old-Time Telegraphers' Association at the meeting last week in New York elected W. H. Young president to succeed John C. Barclay. W. L. Ives was elected vice-president and John Brant secretary. The festivities concluded with a big banquet on Thursday night. Among those present were Thomas A. Edison, Clarence Mackay and a number of gentlemen prominent in electrical circles.

THE SUBMARINE MINE AS A DEFENSE IN WARFARE.

BY A. FREDERICK COLLINS.

It is doubtful if there is any other single factor in modern warfare that induces such genuine dread in both officers and crews of offensive naval fleets as the invisible destructive engines known as submarine mines.

Men trained to look danger in the eye, to laugh at fear and to die smiling, usually welcome a battle of any kind, be it a hand-to-hand struggle or a running fight of armored cruisers, for they are sure of ultimate success regardless of the odds against them, but to be blown up without a ghost of a chance is much like dying the death of a spy, and hence a thing to be studiously avoided.

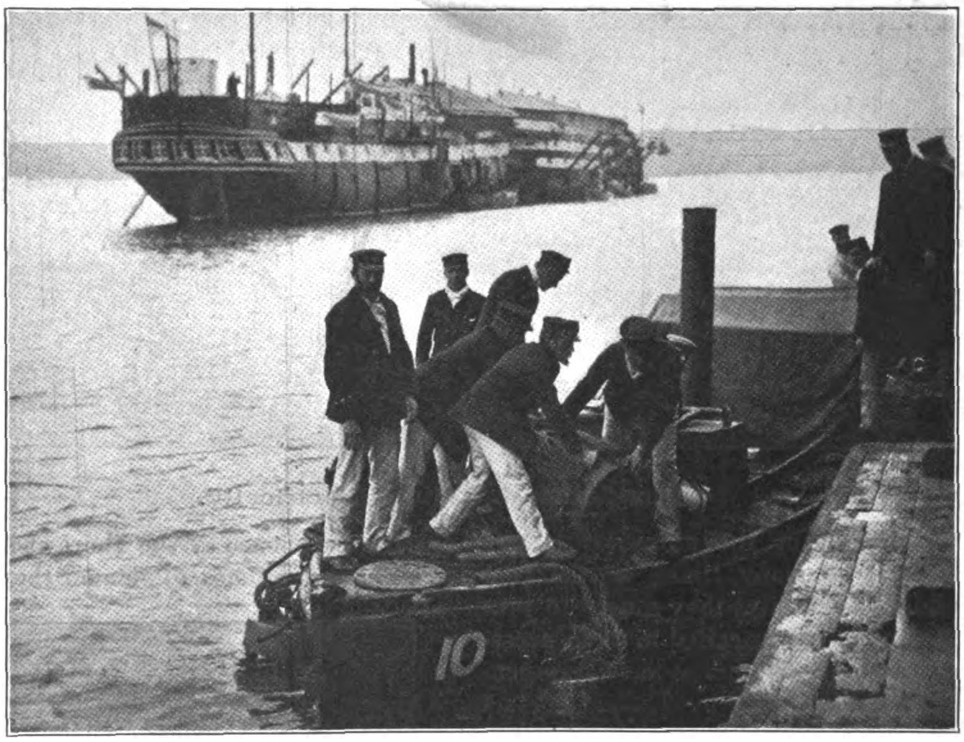
A few years ago representatives of the civilized nations assembled at The Hague to formulate rules to be observed by belligerent powers who might, perchance, prefer to settle their differences by force of arms rather than by arbitration, and one of the articles incorporated in the recommendations was the elimination of balloons or other forms of ærial devices carrying high power explosives, which could be hurled overboard and at one stroke annihilate whole fleets and armies, forts and towns.

On first thought the submarine mine would seem to be as barbarous a mode of destruction as the ærial explosive bomb, for the former like the latter is an unseen element and retaliation by combat is out of the question, yet it possesses a few features that enables it to remain in the class of legitimate destroyers as authorized by the civilized code of warfare.

The chief claim in this respect is that it can be used only as a defensive agent, and then the fact that its powers are limited to a certain circumscribed area—since it is arranged to explode under the vessel that comes in contact with it—renders its use not only permissible but quite justifiable as well. All mines, however, are not arranged to explode by actual contact, for there are many kinds operated in various ways, and so diversified and important is this branch that no navy department is considered complete nor could it be up-to-date without a special school for the training of its sailors in the art.

In the bitter engagements between the Russians and Japanese fleets that have been waged so mercilessly the submarine mine has played no minor part, and it is common knowledge that had not the harbor of Port Arthur been literally covered with these infernal engines and the moral effect they had on the blockading fleet the Russian ships would have been smashed and the land batteries silenced many months before they were and the war terminated long ago.

During the early period of the war Russian vessels occasionally ran amuck of their own mines, in which case it was evident that the mines were of antiquated design; since fulminating caps and guncotton are no respecters of nations the very ships they were intended to protect have been blown up, the crews killed and the fleet in the harbor crippled, all of which goes to show how exceedingly careful those having the mines in charge must be to prevent premature explosions.



Placing Submarine Mines.

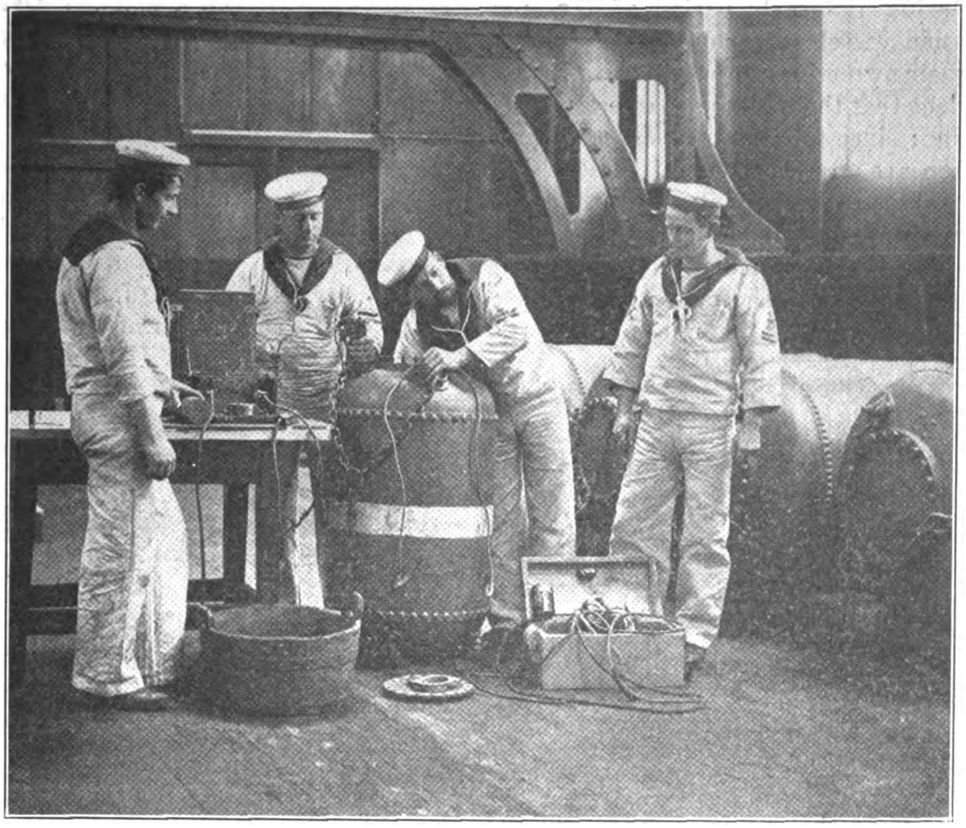
The art embracing the submarine mine and the mining of harbors dates back only to the time of our own Robert Fulton, who may be said to be the inventor of the first submerged mine and the father of this method of defense, for it was he who first exploded a charge of gunpowder under a vessel which was promptly sunk.

From that day to the present time submarine mines have been more or less extensively employed for the protection of harbors, but the standard of efficiency to which they have been brought during the last few years has been chiefly due to the advent of high explosives and electrically-operated devices for exploding them.

Prior to electrically fired mines those that were purely mechanical in operation were extensively employed, and during the war of the rebellion both the Northern and Southern navies made use of a primitive mine formed of a keg of gunpowder and a firing mechanism consisting of a percussion cap, made of a salt of fulminuric acid or fulminate, which would, when struck, produce an explosion and thus ignite the powder. Over the fulminating cap a hammer was so adjusted that it would not strike unless it was pulled quite vigorously; to produce this result at the desired instant a wire connected with the hammer and also to a heavy weight resting on top of the keg.

The keg and firing device was now anchored in the harbor so that if the keel of a vessel should be so unfortunate as to come in contact with it the weight would be dislodged and in consequence would release the hammer, when the inevitable explosion took place. A later contact mine, in which the ignition of the powder was accomplished by a much more ingenious and safer arrangement and by which the uncertain mechanism of the first was gotten rid of, consisted of an iron shell filled with the explosive and from the upper and exterior surface of which and connecting with it were lead tubes which projected to a height of a foot or so.

Inside these leaden tubes there were glass tubes filled with sulphuric acid while between the glass and the lead tube a mixture of chlorate of potash and sugar was placed. The chemical action of the latter ingredients when combined with the acid causes an instantaneous combustion, and this is exactly what took place when a ship's hull struck one of the lead-incased glass tubes, for the sudden impact shattered the tubes, brought the chemicals into active relationship, setting fire to the gun-cotton, which promptly exploding blew up the ship that struck it.

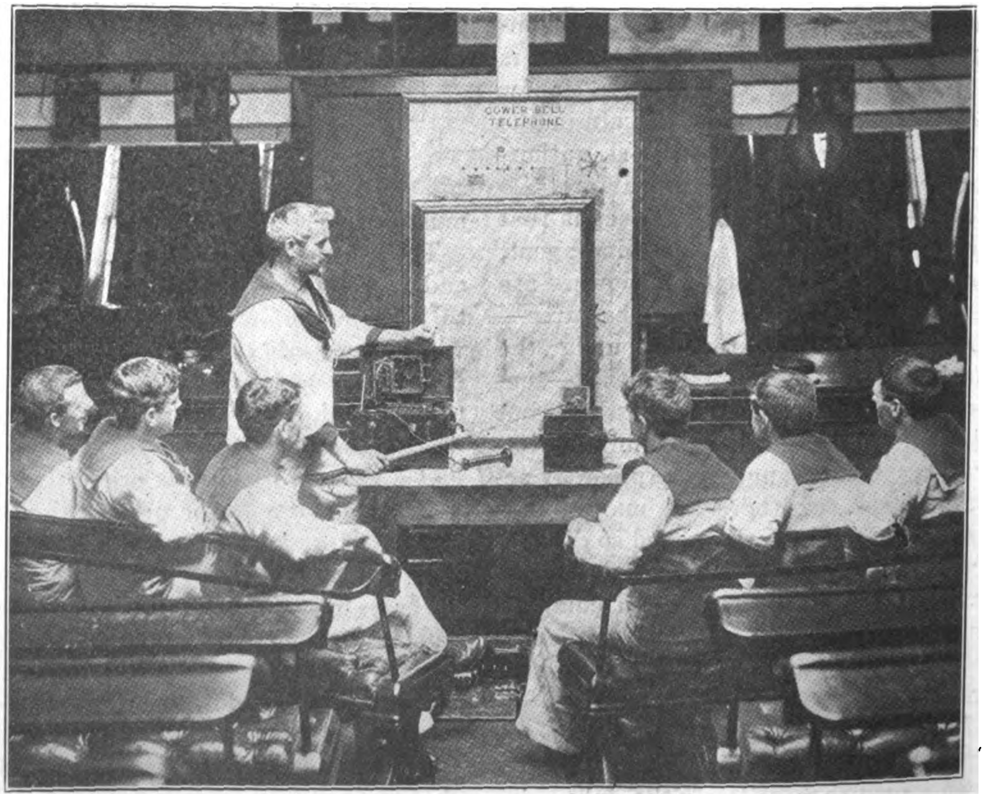


Testing Submarine Mines Electrically.

To circumvent the untoward results that have so many times in the past annihilated the ships they sought to protect, electricity was called in as an accessory, and electrical mines have very generally superseded the mechanical contact mines except in some specialized cases. Like those described the electric submarine mine is a stationary torpedo arranged for the defense of a harbor.

Harbors are protected by placing a number of mines in positions so that they may be readily exploded by means of an electric current from the shore and fired when the ships of the enemy pass over them, yet when the current is cut off it is absolutely impossible to explode them. The mines utilized in modern practice usually contain from 1 to 500 pounds of some high explosive packed in watertight steel cylinders anchored in accurately determined positions and connected with the shore by electric cables.

An operating room at the shore end of the cable is furnished with batteries, contact or firing keys, etc., these comprising the necessary appliances by which the mines can be exploded at a distance by the transmission of an electric current through the cables; in some types of electrically-operated mines they are equipped with automatic circuit closers in which two central projecting points on top of the mine are closed by the passage of a ship. When the home or harbor fleet wishes to manœuvre the circuits are opened at the shore end, but at night and in times of danger they are kept closed, rendering the wires inoperative and harmless or active and destructive as desired.



Instruction in Testing Apparatus on H.M.S. "Vernon."

Another arrangement provides for a weak current constantly flowing through the mine circuit and too feeble normally to ignite the fuse, but instead merely closes a relay in the operating room, which in turn sends a current through a bell or indicator. In time of war, however, the relay closes the circuit when a current flows strong enough to heat a little piece of platinum wire red hot, and this ignites a fulminate of mercury cap when a primer of dry gun-cotton is fired, the detonation of which explodes the full charge of damp gun-cotton in the mine.

Observation mines similar to those of the electrical type just mentioned, but which are fired by observers closing the firing circuit manually, are to be found in the best protected harbors of the world, and it was this kind of mine that wrecked the ill-fated Maine in the harbor of Havana in 1898. Observation mines are submerged either singly or in groups of from three to half-a-dozen, and the cables leading from them to the shore are so laid that the enemy cannot cut them without being exposed to a withering fire from the land batteries.

In this type of mine the operators are located on the shore at two different points, so that a triangle is formed with the mine as the third point. The mine is connected electrically with both the operating stations and in such a way that it can only be exploded when the firing keys in both positions are pressed at the same instant. Thus when one of the mine pickets, as the operators are termed, observes through his glass that the enemy's ship is in a position so that a straight line could be drawn from his eye through the vessel and over the point where the mine is anchored, he presses the firing key; if the second picket also observes the ship passing over the visual line connecting his glass and the mine he likewise presses his key, and if both these keys are pressed simultaneously the mine will be exploded.

It is evident that if only one observation was made showing the vessel on the line and apparently directly over the mine it might be several hundred feet to one side or the other of the submerged explosive, but two observations taken simultaneously from different angles will instantly show whether the vessel is over the desired spot. Recently an invention has been brought out which enables a single operator to determine with absolute precision the position of a vessel, but this naturally requires a much more complicated piece of apparatus.

The testing of a mine is an important feature and each wire is connected to the shore station by a telephone, and when the mine is operative the telephone responds by emitting a humming sound. If this test fails the mine must be brought to the surface of the water and carefully inspected.

The officers of a ship are of course trained in naval academies, but the sailor, who often becomes an adept and sometimes more so than his superior officer, must be taught the principles and drilled in the practice on board some vessel that is especially equipped for the purpose. The illustrations shown were taken on board H. M. S. "Vernon," which constitutes the Naval School of Mines of the British Navy.

IS THE WIRING CONTRACTOR DOOMED?*

BY S. W. WILKINS.

The existing state of the electrical trade is one that affords much food for thought. A transition is happening before our eyes; a new order of things is coming. The past 20 years have witnessed the ruthless exploitation of the great wiring boom, in which fortunes have been made and large businesses built up. Now the trade is settling down to its normal proportions, and we are face to face with the fact that the past affords no indication of the future, and that with the end of the boom the trade has to be carried on under different circumstances entirely. The manufacturing houses can seek new fields abroad, and they have usually so many irons in the fire that dividends can be secured by the elimination or neglect of the unprofitable lines to make room for the more remunerative branches. With the wiring contractor, however, matters are on a different footing. His business is confined within rigorous lines, and there is not usually any room for setting one branch of the business against another.

The wiring contractors' trade a few years ago was a very good one to those who knew their business. The advantages of electric lighting were apparent, and there was a splendid field among the classes to whom first cost was not a great matter, and who did not need to weigh too closely the relative rates for gas and the new illuminant. A large and profitable business was done in apparatus and fittings; new developments were constantly arising to give impetus to trade, and the whole industry prospered. The relations between the wholesale houses and the retailer were the same as those existing in other trades; the retailer was regarded as the necessary distributor of the manufacturer's goods, and the two branches worked in harmony and with mutual co-operation. From these halcyon days down to the present there have been influences at work which have completely changed the whole aspect of affairs. Keen competition has, of course, been the most potent of these influences, but it seems beyond dispute that over and above the ordinary incidences of trade fluctuations, the state of affairs in the past has been abnormal, and that the industry as a whole is now settling down into its groove. What is that groove to be? How are matters going to adjust themselves in the future?

One of the most noticeable features in this evolutionary process has been the disappearance of the mystery surrounding electricity. The man in the street has a very fair general notion of the eccentricities of "juice," and the enterprising ignoramus who has the temerity to inscribe "Electrical Engineer" over his doorway does not strike awe into the passer-by, and find himself regarded as a man of science. Under existing conditions, it is the easiest matter in the world to get together a staff of competent wiremen, if one knows how to go about it. The qualifications necessary to a man before he can undertake a wiring job are so comparatively small, and are possessed by so many, that the number of men willing to undertake such work is legion. Every contractor has his eye on the ever present danger of his right-hand man, after lying low for a few years, leaving his employer to start work for himself, but taking as much of the connection away as possible. It is certain that there can be no lasting stability about a business where such manœuvres are so easily practicable. The result is naturally a gradual process of devolution, the substitution of a horde of master wiremen for the old contracting firms. Such a state of things affords a most tempting bait to other partially allied trades. The builder, the ironmonger, the house decorator and jobber, and the stores, find little difficulty in annexing such electrical work as is going on in their neighborhood. The extra capital required is not great, the stock need be but small, the wholesale houses will give lowest trade terms for the asking, while good wiremen will besiege the doors for employment. Such is apparently the future of the electric wiring business. It must eventually be grafted on the other trades; it is not sufficient to stand by itself under normal conditions; and the above are the trades which are destined to work it. In all branches of electrical work requiring more than ordinary skill, and to which a great responsibility is attached, the manufacturers will invariably step in to do the work, either directly or indirectly. Practically all power installations are now taken by the makers of the machinery, and gradually all pretence of the intervention of a trade man is being dispensed with. Competition is so terribly severe in this class of business that if the manufacturers can only keep their factories going on full time regularly they esteem themselves fortunate. Profit is, of course, highly desirable, but not always obtainable nowadays in motors, and two profits are absolutely out of the question. The same remarks apply in a lesser degree to the general sale of electrical material. Most articles for use with the electric current are fairly costly, and the purchaser will only buy from a firm of good standing and repute—the maker, if he can ascertain who the maker is. Competition is driving the makers to encourage this class of business, and by degrees the contractor is being eliminated. The process is facilitated by the growth of the small man, who is willing to wire up customers' own goods—a thing which the contractor of the old days would have scorned to do without his discount.

The combination of circumstances against the contractor is deeply to be regretted by the trade as a whole. To this cause is attributable the vast amount of shoddy work now being done, with the inevitable ultimate consequence of bringing a certain amount of odium upon electric work in the public eye. Fires, leakages, short circuits, constantly blowing fuses, and all the usual accompaniment of faulty wiring, have been very much in evidence of late, as any one who has had much to do with installation inspection can testify. This, coupled with the growing awakening of the public to the undoubted costliness of electricity at present rates, and the remarkable recrudescence of energy on the part of the gas companies, has had the effect of giving a decided set back to the progress of electric lighting.

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*From the "Electrical Review," London.

In the wholesale and manufacturers' side of the business, the trend of events has effected similar changes, though not with similar results. Competition has become very keen, prices are very low and profit small. New firms of comparatively small capital have sprung up in all directions, either for manufacturing and specializing in one particular class of goods, or for factoring foreign articles. Competition and the decline of the general contractor are gradually compelling all wholesale houses to treat with the general public. They are being loudly blamed for this, but it is not due so much to faulty policy on their part as to the inevitable march of events. In the absence of a strong and prosperous army of retailers to act as the distributors of their goods, the manufacturers must necessarily take on such distribution themselves. Needless to say, they do not wish to do it, as they usually have no machinery for this class of business, but they must look ahead and make provision for the future from a natural instinct of self-preservation.

The attempt on the part of the municipalities to get powers to supply goods through the medium of their generating stations is a sign of the times. With the central stations equipped with showrooms and a commercial department, the electrical trade would be on a level with the gas companies. However one may be opposed to municipal trading, there is something to be said for the promoters of the scheme. The general public have now very few opportunities to inspect the latest things in electrical apparatus; the ignorance of the man in the street regarding the various articles now available for use with the current is remarkable. In short, electrical goods for use on the ordinary house supply are not being pushed. The contractor apparently cannot do so; therefore either the central stations or the manufacturers must do it. The Municipal Supply Bill is a step towards the former; the forthcoming great exhibition at Olympia is a step towards the latter. What will be the final result?

HOTEL WIRING.*

It is the fashion on the Continent much more than here to arrange incandescent electric lamps so that they may be controlled from more than one position. In this country we have hitherto limited the application of the principle mainly to corridor and hall lighting. To be able to switch on a light from either end of a corridor has been recognized as a convenience and adopted, while the same applies in the case of a hall or landing light, which can be controlled from both the foot and head of the staircase. Continental engineers have, however, given the system wider application. In a German hotel, for instance, it is not unusual to find that a bedroom lamp or lamps can be controlled from two different points. Complications are necessarily involved, but convenience is held to be of primary importance in these matters. In a contribution to the "Elektrotechnischer Anzeiger" "A. H." describes some current practice. The diagram (Fig. 1) represents a common arrangement of connections. In this example the lamp, L, is supposed to be fixed in a central position for general illumination, while one single-pole two-way switch, U_1, is placed near the door and another, U_2, within convenient reach of the bed. The lamp, it will be seen, may be controlled from either switch at will. The switches themselves are preferably of the quick make-and-break two-way type. The only complication and possible extravagance where the local conditions are unfavorable is the necessity for three connections to each switch. When surface wiring on porcelain insulators with treble flexible is used it looks ugly, and with conduit wiring it is frequently found necessary to lay two tubes, apart from any preference which may be given to separate wires on account of greater safety. Reverting to the diagram, it should be mentioned that s_1 and s_2 represent fuses. Should it suffice to control the lamp from different points by means of two switches, S_1 and S_2, arranged in parallel as shown in Fig. 2, the connections are considerably modified, two wires only, frequently but one, being then required between the switches, while the substitution of simple for two-way switches represents a further advantage. The use of but one switch wire is possible when a convenient and short connection can be made to the main conductors as indicated by the dotted line in Fig. 2. But this involves the introduction of a third fuse, s_3, whose maximum capacity, together with that of the parallel fuse, s_2, must not exceed that of the lamp lead, l. This arrangement enables the lamp, L, to be switched on from either of the two positions, but both switches must be set in the off position before it can be extinguished. In order to obtain maximum convenience from the arrangement it must, therefore, be remembered to set the door switch to the off and the bedside switch to the on positions respectively before retiring. Another arrangement frequently met with includes two lamps so connected that only one can be used at a time. A suitable, and at the same time simple, means of accomplishing this end is illustrated in the diagram (Fig. 3).

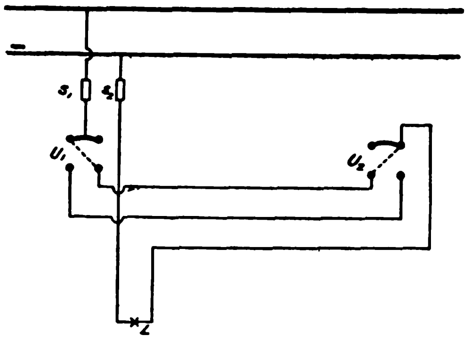

FIG. 1.

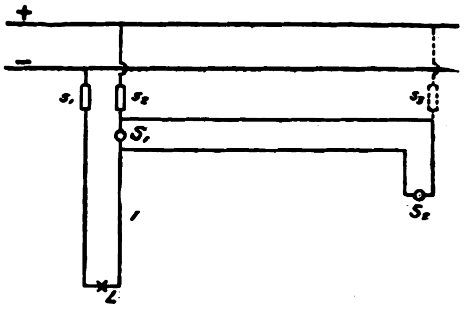

FIG. 2.

It is assumed here that one of the lamps, L_1, serves for the general lighting of the room, while the other, L_2, is fixed near the bed or writing desk, but in any case may be extinguished through a switch, S, placed within convenient reach of the bed. Referring to the diagram, it

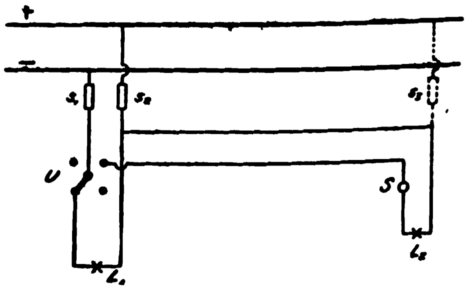

FIG. 3.

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*From the "Electrical Engineer," London.

will be seen that a two-way switch, U, and an ordinary single-pole switch are requisite in this case, while between the two, as in the previous example, two wires are required at the most and frequently under favorable conditions only one. A dotted line is again employed to represent the alternative connection whereby it would be possible in favorable circumstances to effect the saving in question. But in that event it would be necessary to add a third fuse, s_3, of equal capacity to the other two. When complexity and cost are secondary to convenience the arrangement just described may be modified as shown by the diagram Fig. 4. This modification enables the second lamp L_2 to be controlled—say, from the door switch, when the other switch is in any position. In the case of the arrangement, Fig. 3, on the other hand, with the simple switch s open, it would be impossible to switch on the second lamp L_2 from the door. But in addition to a greater number of wires the arrangement, Fig. 4, involves the use of a two-way and a three-way switch, U_2 and U_1, respectively.

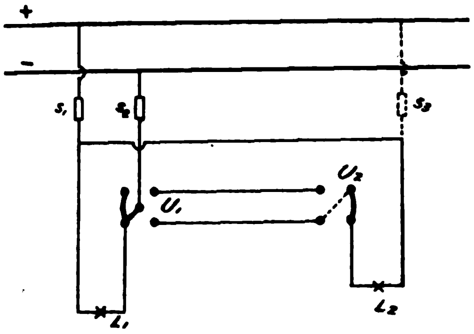

FIG. 4.

In conclusion, reference may be made to an arrangement for controlling three lamps so that one only can be used at a time, This condition necessitates the employment of a three way switch, U_1 (Fig. 5), provided with intermediate dummy contacts, so that in the positions 1, 2 and 3 the corresponding lamps, L_1, L_2, or L_3, are switched on, while no circuits are closed through the dummy contacts. It is assumed that the lamp, group of lamps, or electrolier, L_2, serves for the general illumination of the room, while L_1 and L_3 are desk and bedside lamps respectively. It would be well, adds "A. H.," to provide the last-mentioned, especially the bedside lamp, with separate single-pole switches or switch-holders for local control. The dotted line indicates how a possible saving in wire might be affected. But here, again, this saving would entail the use of a third fuse.

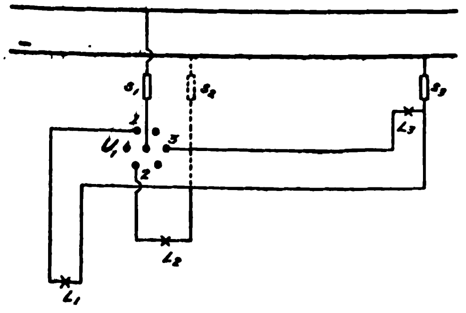

FIG. 5.

WIRING FOR LAMPS AND MOTORS—MEETING AN EMERGENCY.

BY W. H. WAKEMAN.

ARTICLE I.

The incident which constitutes the basis for these articles is presented at this time because it will amuse readers who are expert electricians and benefit others who are always looking for "pointers" that serve to instruct in the art of wiring an electric plant, and assist in presenting plans for meeting emergencies as they arise in every-day practice.

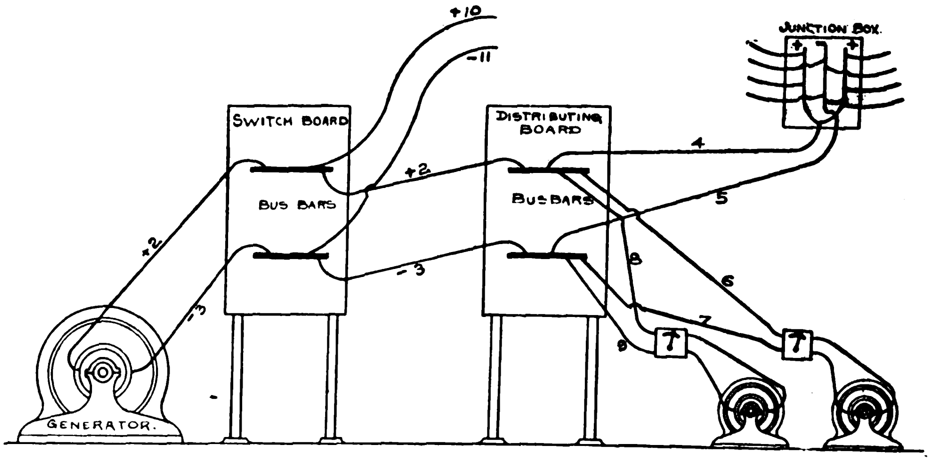

FIG. 1.

Inasmuch as this is a portion of my own experience in an electric plant forming part of the equipment of public buildings, I do not wish to give it greater prominence than its importance calls for, but having debated mentally the question as to whether it is of enough value to warrant its publication, and decided that a full description of the plan of wiring, also of changes made to meet an emergency, contains valuable points, they will be presented in full, as otherwise the matter would not be valuable to anybody. Switches and other unnecessary details are omitted for the sake of simplicity.

The generator in Fig. 1 supplies a 110-volt direct current for incandescent lamps and induction motors. The wires 2 and 3 transmit this current to and from a switchboard in the engine room. From these bus bars it goes to a distributing board located in another building. This board is supplied with three bus bars, as the building is fitted to receive either the two or three-wire system of transmission, but as the former is used here, only two bars are shown.

There are six switches on this board, but only the main switch and two others are concerned in this description. One of these controls the wires 4 and 5 taking current to and from the junction box shown.

This is supplied with fixtures for a three-wire system, but as only two are used the positive wire 4 is spliced, thus dividing the current and supplying the two outside wires while 5 is the negative wire.

Here we have a distributing board and a junction box both fitted with three wire fixtures, but they are connected with two wires only and the system works perfectly. This naturally causes us to ask why provision is made for three wires when only two are wanted. This may be explained for this case by saying that two wires answer every purpose for the amount of current wanted, but if more is required than these can carry, another generator must be put in and three wires substituted for the pair now used. This is one way of providing for more current to be used in the future.

The other switch controls two 20 hp. motors, the wires 6 and 7 connecting with a rheostat and starting lever, thence continuing to one motor. The wires 8 and 9 connect with another rheostat, thence continuing to the other motor.

The generator is driven by a direct connected engine, at 300 revolutions per minute, maintaining the required voltage with very little vibration, although it rises when more load is put on, showing that the machine is "over-compounded."

The wires 10 and 11 in Fig. 1 connect with 10 and 11 of Fig. 2, forming a cross-connection between the two switchboards that can be used as follows:

The dynamo in Fig. 2 supplies a direct

current at 110 volts to operate lamps in another building, although both generator and dynamo are in the same engine room. Current is carried to and from the switchboard by wires 12 and 13, but if for any reason the dynamo is not used current can be taken from the generator (Fig. 1) coming over wires 10 and 11, which connect with 10 and 11 (Fig. 2), as already mentioned, thus making it possible to run one machine only when but a small amount of current is wanted.

Under these conditions the voltmeter and ammeter (Fig. 1) operate as usual, while the voltmeter (Fig. 2) follows the other but cannot be varied by its own rheostat. The ammeter is not affected.

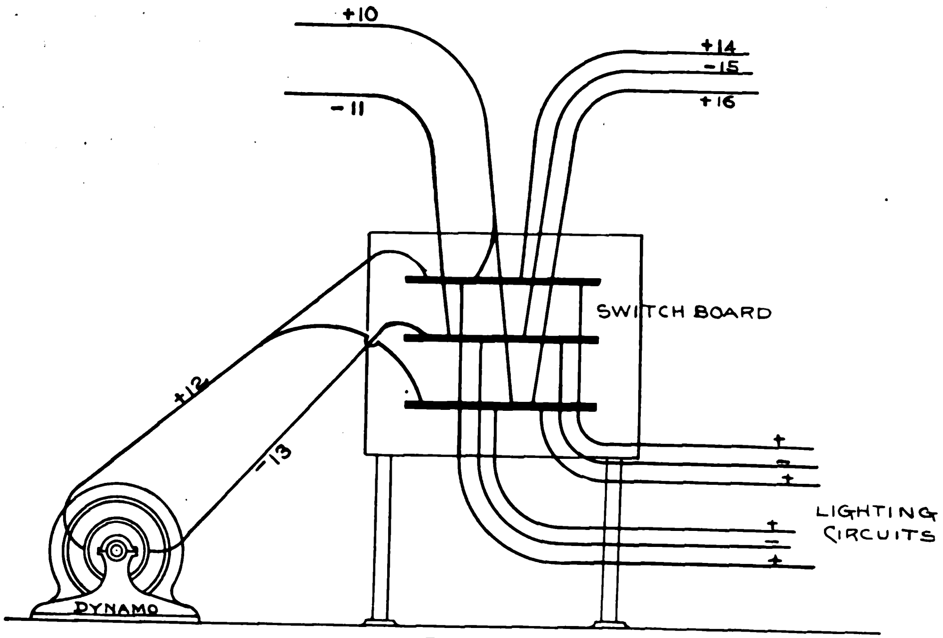

Fig. 2.

On the other hand if the generator (Fig. 1) is idle current may be taken from the dynamo (Fig. 2) and transmitted over wires 10 and 11 to the switchboard (Fig. 1).

Under these conditions both voltmeter and ammeter in Fig. 1 must be disconnected, as current passing through them in the wrong direction tends to force both pointers backward. Both instruments in Fig. 2 operate correctly.

It is not practical to operate these machines together in multiple for the following reason: The generator is fitted with 10 poles and revolves 300 times per minute at a practically uniform speed, causing very little vibration of the voltmeter.

The dynamo is fitted with four poles, and while it is calculated to revolve 1,050 times per minute the speed is very unsteady, causing the voltmeter pointer to vibrate a maximum of 20 volts at times. The engine which drives this dynamo revolves 75 times per minute nominally, but it is fitted with a governor that allows much variation in speed. This engine drives other machinery, and as this gives an ever-changing load it accounts for the vibration mentioned.

While it is not impossible to run these machines in parallel, I have considered it safer and better, owing to the reasons given and other conditions peculiar to this plant, to keep them in separate operation.

In the circuit formed by wires 10 and 11 there are two switches, one on each switchboard. If both of these were thrown in, while generator and dynamo are in use, it would undoubtedlv cause trouble, and as ever-changing conditions call for frequent changes in switches, it is necessary to use much caution to prevent accident. In every such case the engineer should stop a few seconds and consider the effect before throwing in a switch. This is recommended without regard to the fact that the engineer is often in a hurry to do something else. It takes but part of a second to throw in a switch, but it may take several days and a respectable sum of money to repair damage caused by throwing in the wrong one.

Tantalite Incandescent Lamps.

In the course of a lecture at a joint session of the Technical and Electrotechnical Associations of Frankfort, Dr. Feuerbach, a director of the incandescent lamp works of the electrical establishment of Siemens & Halske, Berlin, said the tantalite incandescent lamp was the result of years of experiment by the firm of Siemens & Halske. Dr. von Bolton, chemist of the Siemens & Halske works, after laborious and painstaking experiments, first succeeded in obtaining pure tantalite. Tantalite is a heavy mineral with a grey metallic luster, extremely resistant to acids and alkalies. Its melting point lies between 4,092 degs. Fahr. to 4,172 degs. Fahr. The technical use of large quantities of tantalite is at present impracticable, as one pound of this element costs nearly $5,000. Of what importance the chemical and physical properties of tantalite are for the industries is shown by the fact that Siemens & Halske, for the various processes of manufacture and use of tantalite, have taken out more than 200 patents in Germany and other countries. The incandescent lamp with a tantalite instead of a carbon thread requires only one-half the current of ordinary incandescent lamps of equal light power. With the same strength of current the tantalite lamps give double the light of the carbon incandescent lamp and the light is much whiter. The lamp now being made is pear-shaped like the ordinary incandescent lamp, and the thread has a length of 25.29 inches, and is 0.197 inch in diameter.

DETERMINATION OF THE SPECIFIC ELECTRICAL RESISTANCE OF COAL, ORE, ETC.*

BY G. C. WOOD, B.SC.

Introduction.—The samples of coal, ore, etc., used in this investigation may be grouped as follows: (1) Coal, and the rocks lying immediately above and below; (2) ironstone, and the rocks lying above and below; and (3) lead-ore and the adjacent rocks. In order to obtain the electrical resistance of the coal, ores, etc., the specimens were worked into shapes with parallel faces. A paste of black-lead and water was spread evenly on the faces and dried. A copper plate was cleaned, on this was laid a sheet of tinfoil, and on this again was placed the sample with one of its blackened faces on the foil. On the top of the specimen was placed another sheet of tinfoil and then another copper plate. Thus contact could be established at the two copper plates, and such a weight was laid on the top as experiment showed would make good contact. The method employed in the measurement of the samples was one or other of the following: (a) Wheatstone bridge; (b) high resistance substitution; and (c) the high resistance leakage. The specimens of coal examined were supplied from the Cowpen, Harton and Murton collieries. The iron-stone was supplied from Skelton Park mines. The lead-ore examined was supplied from the Greenside mines, near Penrith.

The author describes in detail the experiments made on six kinds of coal as obtained from the three collieries mentioned in the Newcastle district. The actual figures will be found in the table which appears at end of this article. In order to show the method of procedure we give the following details of the experiments made on the Cowpen Colliery coal. The specific resistance (a) of the black shale roof was determined by the (b) method with a piece with an area of 130.4 square centimeters and a thickness of 1.2 cm., and was 4,090 ohms, and the specific resistance was 444,800 ohms per cubic centimeter. The resistance of another piece with an area of 29.8 square centimeters and a thickness 1.12 cm. was 16,800 ohms, and the specific resistance was 446,400 ohms per cubic centimeter. The mean specific resistance was 445,600 ohms per cubic centimeter.

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*Abstract of paper read before the Institution of Mining Engineers at Newcastle-on-Tyne, England.

Coal.—The sample of gas coal supplied from this colliery was of such a shape and so easily worked that one piece was obtained of fairly large cross-section. The resistance (method c) of a piece with an area of 96.3 square centimeters and a thickness of 3 cm., was 1,120 megohms, and the specific resistance was 36,000 megohms per cubic centimeter.

Grey Sandstone Thill.—The resistance (method b) of a piece with an area of 30.2 square centimeters and a thickness of 2.8 cm. was 1,900 ohms, and a specific resistance was 20,500 ohms per cubic centimeter. The resistance of another piece with an area of 18.4 square centimeters and a thickness of 1.2 cm. was 1,310 ohms and the specific resistance was 20,100 ohms per cubic centimeter. The mean specific resistance was 20,300 ohms per cubic centimeter.

The experiments on the iron stone and its surrounding strata were carried out in the same way, and the experiments on the lead ore were likewise similar. In this case, however, smaller samples were used. The results obtained with direct current and small voltages were confirmed by other experiments, using variable current in a Wheatstone bridge method. In this case the telephone took the place of the galvanometer and a microphone was inserted in the battery circuit. Other experiments with voltages of 100, 200 and 220 volts were used for determination of the resistance of the samples which were connected in series with the voltage and with a tangent galvanometer. For all the specimens that could be measured this way it was found that there was practically no difference from their resistances as obtained. The samples of coal had too high a resistance to be determined by this method. From an examination of the results of the tests, as given in Table 1, it will be seen that lead ore is the only ore which, by practical tests, based on differences in electrical resistance of large masses, could, with certainty, be distinguished from its surrounding rocks. It may also be noticed that coal, and especially hard steam coal, has a comparatively high electrical resistance. This important result should be borne in mind in connection with practical work. The following values in megohms per cubic centimeter indicate the magnitude of the specific resistance of coal and other well-known bodies: Gutta-percha, 400,000,000; arc-light carbon, 0.000,000,004; and coal, say, 40,000. Coal has, consequently, ten million times greater resistance than arc-light carbon, and ten thousand times less resistance than gutta-percha of the same dimensions.

The author had previously experimented with the carboniferous limestone used as ballast on the North-Eastern Railway, and found a specific resistance of 1,014,000 ohms per cubic centimeter. A piece of cement concrete flooring was found to have a specific resistance of 754,000 ohms per cubic centimeter.

TABLE I.—Specific resistances of Minerals found in Mines.

Name of mine.	Description of mineral.	Specific resistances per cubic centimetre (ohms).
Cowpen	Roof: black shale	445,600
Ditto	Gas coal	36,000,000,000
Ditto	Thill: grey sandstone	20,300
Harton	Roof: black shale	337 500
Ditto	Steam coal: top panel	80,100,000,000
Ditto	Ditto bottom panel	*
Ditto	Gas coal	33,000 000,000
Ditto	Coarse coal	3,396 000,000
Ditto	Thill: bluish-grey posty shale	105 900
Murton	Roof: soft blue shale	432,900
Ditto	Coal	33,900,000,000
Ditto	Thill: blue shale	13 000
Skelton Park	Roof: dogger rock	52 100
Ditto	Ironstone	167,000
Ditto	Thill: bottom rock	52,050
Greenside	Lead ore	7?
Ditto	Old red sandstone	8,375 000
Ditto	Mountain limestone	2,900,000

* This value is omitted from the table, as the specimen contained iron pyrites.

WRINKLES.*

EDITED BY H. C. ABELL.

A Cheap Vacuum.

An artesian well with a good head of water is very valuable for condensing purposes. We have had such a well in use for the past ten years and at present we are still using it. The well is an eighth-inch well, bored on the banks of the San Antonio River, immediately back of the plant. It has a pressure of 15 pounds at the mouth of the well, and the head water, if measured above the water level of river, is 49 feet. This is sufficient head to carry the water to a Buckley condenser, injector type, which is placed on the roof of the plant. After the water does its work the greater part of it—that is, the overflow of the hot wells—flows away into the river, nothing being lost by this waste of water.

It is a valuable asset, for it needs absolutely no attention and repairs. Besides, it saves the first cost and maintenance of pumps and steam to run these pumps, also the cost of water and cooling towers, if the water had to be purchased. Among the other good features that the well presents is that it needs no attention that pumps would require, always giving us a steady stream of water, and we never need fear a "lost vacuum" for lack of water.

G. H. CUSHMAN,
San Antonio, Tex.

Scheme to Avoid Lifting Feed Water.

A represents deep well; B, an electric pump; C, a pump; D, a steam pump for pumping water from C to tank H, on roof of boiler house; G, closed feed-water heaters; F, open feed-water heater; E, boiler feed pump; M, batteries of boilers;

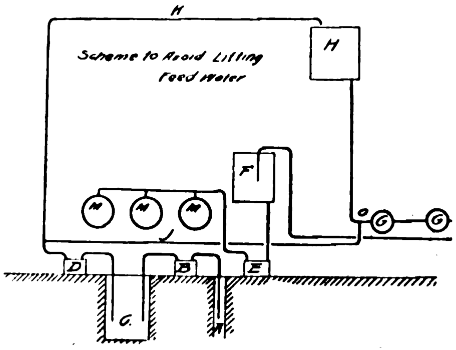

DIAGRAM OF CONNECTIONS.

K, old line to tank on roof; J, new line running from D to O, the outlet pipe from supply tank.

The feed water is pumped direct from D to G through J, while formerly it was lifted to H, a vertical distance of 60 feet. Now only the excess water is lifted to supply tank. Heat is also saved, as water in C is heated to some extent.

B. E. BUTTLES, Denver, Col.

An Approximate Method of Metering the Boiler Feed Water.

We experienced a good deal of trouble with the water-meter used to measure our feed water, until one day we had to discard it altogether. To keep tab on the water used, an old integrating wattmeter counter was rigged up with a ratchet and pawl on the last dial and fitted on our feed pump so as to go forward one division for every stroke of the pump. From the size of the plunger and stroke one can calculate the amount of water per stroke. The leakage coefficient of the pump has to be determined, and this is often very hard to get at accurately. However, from observations taken, this coefficient was found to remain practically constant, and at the worst with the above outfit you can get a very good comparison of the feed-water consumption from day to day.

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*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

L. Denis, Montreal, Can.

Operating Engines Condensing When Short of Water.

The steam plant in connection with the Quebec-Jacques Cartier Electric Company is used as an auxiliary in case of trouble or breakdown at the water-power plant in summer time, and to help out the latter regularly in winter, when the load on the plant increases considerably.

The diagram shows the arrangement and piping of our water tanks. Under ordinary conditions the cold-water tank is supplied from the city main through a pipe—which is not shown—and the hot well is allowed to overflow into the drain pipe. The boiler-feeder pump is supplied from either the hot well or the cold water tank by opening valve A or valve B.

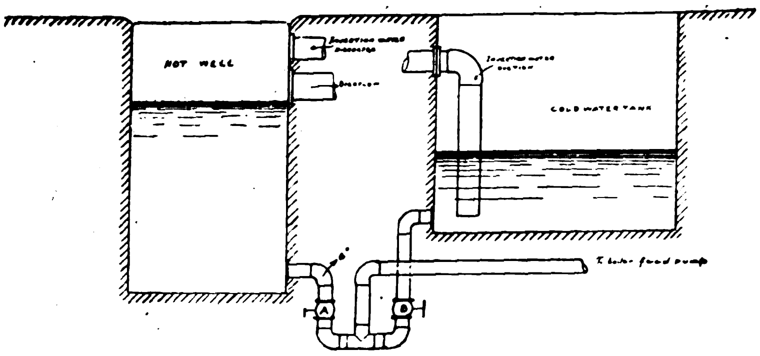

Diagram of Connections.

On the particular occasion referred to, the city unavoidably had to shut off the water for a whole day to repair a leak, and it was up to the steam plant to run at least one 500 hp. set to help out the water-power plant. The tanks were practically full and it was thought at first to run non-condensing, but, even then, we should not have had water to run more than three or four hours, so the following plan was tried and found to work remarkably well:

A condenser pump was started as usual, and the feed-pump piping had valve A open and valve B closed. The water in the cold-water tank was allowed to drop about 1 foot below the level of the overflow in the hot well, then valve B was opened. The difference of level between the two tanks allowed the water to flow from the hot well to the cold-water tank through the feed-pump piping, thus practically losing no water. The only thing remaining to be done was to keep the water in the cold-water tank cool. This was done by keeping the tank well provided with snow, which we had in plenty, but it kept two men and a rig busy carting. The melted snow more than overbalanced the water lost through leaks or otherwise, and this plan could have kept us running almost indefinitely, as long as we could have been kept supplied with snow or ice.

L. Denis,
Montreal, Can.

Detecting a Poor Vacuum.

The vacuum on a compound engine was noticed very low. All stuffing boxes were repacked, suction pipe and pump examined, candle test was made for leaks, but nothing found. By turning steam pressure on exhaust pipe between engine and condenser a number of very small leaks were found; these were too small to be found with candle test, but were in the aggregate sufficient to impair the vacuum. A new length of pipe was the remedy and fixed things O. K.

H. C. Hall, Fall River, Mass.

THE BRITISH ASSOCIATION.

"Celestial Evolution" the Subject of the Second Part of Prof. Darwin's Presidential Address.

Prof. G. H. Darwin, F. R. S., delivered the second part of his presidential address before the British Association for the Advancement of Science on Thursday last, August 31, at Johannesburg, South Africa. In last week's Electricity we printed the first part of the address. The Johannesburg discourse is very interesting. Prof. Darwin declared it not unreasonable to believe that from 500,000,000 to 1,000,000,000 years had elapsed in the evolutionary history of our earth since the birth of the moon. He also gave some details in regard to which, as he had said in his first address, the discovery of radium and its properties had upset the calculations of the scientists.

Discussing the Nebular Hypothesis as suggested by Kant and restated by Laplace, and considering the influence of tidal oscillations, he said the system might be traced back to a time when the day and the month were identical, both being only about four or five of our present hours. The moon at that time must have been only a few thousand miles from the earth's surface—a great contrast with the present distance of 240,000 miles. It might well be argued from this alone that the moon separated from the earth more or less as a single portion of matter at a time immediately antecedent to the initial stage to which she had been traced. If at every moment since the birth of the moon tidal friction had always been at work in such a way as to produce the greatest possible effect, Prof. Darwin said, 60,000,000 years would be consumed in this portion of evolutionary history. The true period must be much greater. Pure geology pointed to some period between 50,000,000 and 1,000,000,000 years, the limit being the more doubtful. Thus the geologists did not find anything which rendered the tidal theory of evolution untenable.

Physicists from a calculation of the total output of the sun's heat, had regarded it necessary that the whole history of the solar system be comprised within 20,000,000 years. He always had believed that the geologists were more nearly correct. Recent marvelous discoveries in physics showed that concentration of matter was not the only source from which the sun might draw its heat. Radium was a substance which was, perhaps, millions of times more powerful than dynamite.

It was estimated that an ounce of radium would contain enough power to raise 10,000 tons a mile above the earth's surface. The energy needed to tow a ship of 12,000 tons for 6,000 sea miles at 15 knots was contained in 22 ounces of radium. The Saxon probably burned 5,000 or 6,000 tons of coal on a voyage approximately the same length,

The earth contains radio-active materials, and it was safe to assume that it forms in some degree a sample of the materials of the solar system. Hence it was almost certain that the sun was radio-active also. This branch of science was yet in its infancy, but already scientists saw how unsafe it was to dogmatize on the potentialities of matter.

Prof. Darwin referred to the inconceivably vast multitude of stars and nebulae revealed by photography. A celestial photograph, he said, looked at first like a dark sheet of paper splashed with whitewash, but further examination showed that there was method in the arrangement of the white spots. It was possible to obtain general ideas as to the succession of events in stellar evolution.

The conviction was forced that the wispy clouds represented the earliest stage of development, the more condensed nebulae a later stage, and the stars themselves the last stage. Change, obviously was in progress everywhere, but scientists were unable even to form conjectures as to the tendency of the evolution. In conclusion, Prof. Darwin said:

"We have seen that it is possible to trace the solar system back to a primitive nebulae with some degree of confidence and that there is reason to believe that the stars in general have originated in the same manner. But such primitive nebulae stand in as much need of explanation as their stellar offspring,

"Thus, even if we grant the exact truth of these theories, the advance toward an explanation of the universe remains miserably slight. Man is but a microscopic being, relatively to astronomical space, and he lives on a puny planet circling round a star of inferior rank. Does it not, then, seem as futile to imagine that he can discover the origin and tendency of the universe as to expect a housefly to instruct us as to the theory of the motions of the planets?

"And yet, so long as he shall last, he will pursue his search, and will, no doubt, discover many wonderful things which are still hidden. We may, indeed, be amazed at all that man has been able to find out, but the immeasurable magnitude of the undiscovered will throughout all time remain to humble his pride. Our children's children will still be gazing and marveling at the starry heavens, but the riddle will never be read."

Convention of Municipal Electricians.

The tenth annual convention of the International Association of Municipal Electricians was held at the Reed House, Erie, Pa., August 23, 24 and 25. A number of interesting papers were read and discussed.

New Haven, Conn., was selected as the place for the next convention.

The following officers were elected: President, Jerry Murphy, Cleveland, O.; vice-presidents, William Crane, Erie, Pa.; H. R. Allensworth, Columbus, O.; B. A. Blakey, Montgomery, Ala.; F. A. Cambridge, Winnipeg, Man.; secretary, E. P. Foster, Corning, N. Y.; treasurer, C. E. Deihl, Harrisburg, Pa. Executive Committee—T. C. O'Hearn, Cambridge, Mass., chairman (inspection); A. S. Hatch, Detroit, Mich. (electric lighting); J. B. Yeakle, Baltimore, Md. (fire alarms); Louis Gascogne, Detroit, Mich. (underground construction); W. M. Petty, Rutherford, N. J. ("Question Box"); James Grant, New Haven, Conn. (membership); W. H. Thompson, Richmond, Va. (associate members); W. Y. Ellet, Elmira, N. Y. (aerial construction). Finance Committee—W. D. Clayborne, J. F. Macdonald and H. C. Bundy.

Proposals Invited.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until September 19 for furnishing Eastern navy yards with the following supplies: Schedule 108, electric cable; schedule 109, incandescent lamps, circuit breakers, panels, ammeters, dry cells, compound, and electrical supplies; schedule 111, motors and miscellaneous electrical supplies. Blank proposals may be obtained at the Navy Pay Office in New York or of the Bureau in Washington.

On October 3 the Bureau will open bids for furnishing Western navy yards with the following: Schedule 114, electric fixtures; schedule 115, electric fixtures. Blank proposals may be obtained on application to the Bureau.

The Bureau of Supplies and Accounts is inviting sealed proposals until October 3 for furnishing and installing ready for use a complete storage battery installation on board the U. S. steamer Adder at the Norfolk Navy Yard. Applicants for proposals should call for Schedule 121, E. which can be obtained of the Bureau or at the Navy Pay Office in Norfolk, Va.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED AUGUST 29, 1905.

Electric Railways and Appliances.

798,069. Car-Fender. William W. McClung, Butler, Pa. Filed April 29, 1905.

798,097. Trolley-Stand. Boniface A. Grasberger, Richmond, Va. Filed Dec. 12, 1904.

798,173. Gear-Casing for Electric Railway-Motors. Henry R. Edgecomb, Edgewood Park, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Aug. 17, 1904.

798,227. Electric Railway-Motor. Norman W. Storer, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Aug. 6, 1904.

798,368. Third-Rail Contact-Shoe. Samuel B. Stewart, Jr., Schenectady, N. Y., assignor to the General Electric Company, Filed May 5, 1904.

798,394. Trolley. Frederic C. Cottrell, Taunton, Mass. Filed April 26, 1905.

798,439. Trolley-Wire Finder. Peter McDonald, Harrison, N. J. Filed Oct. 8, 1903.

Electrical Machinery and Apparatus

798,074. Power-Transmitting and Speed-Controlling Mechanism. Dycke H. Reimers, Chicago, Ill. Filed April 7, 1905.

798,082. Automatic Controller for Electric Circuits. August Sundh, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Filed Feb. 7, 1903.

798,156. Cooling Apparatus for Electric Generators. Benson Bidwell, Chicago, Ill., assignor to Wilmer S. Snow, same place. Filed Nov. 25, 1904.

798,160-161-162. Control System and Controller for Electric Circuits. Eugene R. Carichoff, East Orange, N. J., assignor to the General Electric Company. Filed Nov. 4, 1903, and June 30, 1904.

798,171. Circuit-Breaker. Harry P. Davis, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Dec. 26, 1901.

798,222. Ventilating Device for Cores of Electrical Machines. Robert Siegfried, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Jan. 3, 1905.

798,237. Controller for Alternating-Current Motors. Hermon L. Van Valkenburg, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 2, 1904.

798,260. Method of Insulating Electrical Conductors. William A. Bristol, New York City. Filed Dec. 3, 1904.

798,270. Pressure-Operated Electric Switch. Edward H. Dewson, Edgewood Park, Pa., assignor to the Standard Traction Brake Company. Filed Nov. 2, 1901.

798,279. Brush or Collector for Dynamo-Electric Machinery. Josef H. Hallberg, Cincinnati, O. Filed Feb. 15, 1904.

798,290. Electrically-Actuated Reciprocating Tool. Alonzo W. McArthur, Lynn, Mass., and John G. Crawford, Chicago, Ill. Filed Aug. 26, 1901. Renewed Jan. 21, 1905.

798,342-410. System of Motor Control and Controller. George H. Hill, Schenectady, N. Y., assignor to the General Electric Company. Filed Sept. 30, 1903, and May 2, 1904.

798,365. Insulation of Electric Conductors. George H. Rupley, Schenectady, N. Y., assignor to the General Electric Company. Filed Jan 30, 1905.

798,374-375. Electric Switch and Controller. Harold E. White, Schenectady, N. Y., assignor to the General Electric Company. Filed March 22 and April 7, 1904.

798,391. Motor-Driven Machine-Tool. Harold H. Clark, Lynn, Mass., assignor to the General Electric Company. Filed April 9, 1903.

Telephones and Telephone Apparatus

798,123. Telephone-Switchboard. Joseph L. Wright, Cleveland, O. Filed July 28, 1904.

798,252. Antihummer for Telephone-Wires. Benjamin P. Bartlett, Norway, Kan. Filed Oct. 19, 1904.

798,555. Switch or Cut-Out for Telephones and Circuits. Charles Adams-Randall, New York City, Filed Sept. 17, 1904.

798,561. Common-Battery Lock-Out Telephone. Mark P. Boone, Peru, Ind. Filed April 11, 1905.

Miscellaneous.

798,062. Insulated Handle. Arthur E. Hobson and John G. Brown, Meriden, Conn.; said Brown assignor to said Hobson. Filed June 28, 1904.

798,143. Electric Alarm-Clock. Joseph McCarthy, St. Louis, Mo. Filed May 5, 1904.

798,196. Conduit for Electric Wires. Robert W. Lyle, New York City. Filed Feb. 24, 1903.

798,202. Sound-Receiving Means for Submarine Signaling. Josiah B. Millet, Boston; Edward C. Wood, Somerville, and Horace B. Gale, Natick, Mass., assignors to the Submarine Signal Company, of Waterville, Me., and Boston, Mass. Filed Nov. 21, 1903.

798,235. Insulator. William R. Twiggs, Sandusky, O. Filed May 9, 1904.

798,236. Electric Annunciator. Hans Usener, Kiel, Germany. Filed Jan. 4, 1905.

798,300. Electrical Water-Heater. Eli E. Sager, Vancouver, Canada. Filed Feb. 14, 1905.

798,339. Electric Vibrator. Henry J. Heeney, Boston, Mass., assignor to the Holtzer Cabot Electric Company. Filed Nov. 22, 1904.

798,383. Vacuum-Tube. William S. Andrews, Schenectady, N. Y., assignor to the General Electric Company. Filed May 10, 1900.

798,413. Thermostatic Bar. Charles D. Howard, Syracuse, N. Y. Filed Sept. 17, 1904.

798,414. System of Electrical Distribution. Albert S. Hubbard, Greenwich, Conn., assignor to the Gould Storage Battery Company, New York City. Filed June 24, 1903.

798,452. Electrical Signaling System. Joseph P. Sauer, Wheaton, and Samuel E. Johnson, Lombard, Ill. Filed Sept. 19, 1904.

798,481-482-483-484. Electrocapillary Apparatus and Method of Actuating Electrocapillary Apparatus. James T. Armstrong and Axel Orling, London, Eng. Original application filed May 19, 1902. Divided and this application filed Feb. 2, 1904.

THE TELEPHONE WORLD.

Development of Independents.

By a new arrangement of the Independent Telephone Securities Company, which is the holding organization in the recent deals which have brought the Independent telephone interests in Rochester, Syracuse, Rome and Utica, N. Y., in close alliance, the State, it is said, will be divided into three sections for the more complete development of the business.

The new divisions will be called the Rochester division, the Syracuse division and the Utica division. A general manager will supervise the business in each. George R. Fuller, of Rochester, is vice-president and general superintendent of the Independent Telephone Securities Company.

The selection of a general manager for the Independent Telephone Company of Syracuse has not yet been named. A report from Utica says that Charles H. Poole, of that city, has been made general manager of that division, with headquarters in Utica. Under Mr. Poole's management there will be 32 exchanges with over 10,000 telephones. His division will reach from Watertown to Oneonta and from Herkimer to Syracuse.

The Independent Telephone Securities Company has now under construction a local long distance telephone line from Herkimer to Rochester. From Rochester the line will extend west and from Herkimer it will extend to Albany.

Telephones on Limited Trains.

Announcement is made by the passenger department of the New York Central lines that in addition to other features telephone service has been installed on the Twentieth Century Limited and the Lake Shore Limited trains. Passengers can thus communicate with persons at the important cities along the route of these trains without leaving the train. The system is connected at each city with the regular telephone service through the system's telephone exchanges and no charge is made for using the telephones on the train.

Permission for the construction of the York State telephone conduit was lately granted at a meeting of the Binghamton common council. Work on the subway will be begun at once, according to the declared intentions of the company, and the conduits will probably be completed before winter. The matter of a subway has been hanging fire for considerable time. When the subject was first brought up, considerations for a municipal subway were entertained, but the proposition was abandoned almost as soon as the plan was evolved.

The Springfield-New Carlisle, O., Telephone Company has organized with the following officers: President, C. D. Juvenal; vice-president, J. C. Williams; secretary and treasurer, W. W. Morris.

The work of improving the telephone system at Santa Clara, Cal., is almost completed, and the change to the four-party line is a great improvement.

J. B. Pierce will act as general manager of the Independent Telephone Company of Syracuse, N. Y.

School for Telephone Girls.

The first of this month a school for telephone girls was opened in Brooklyn, N. Y., by the New York & New Jersey Telephone Company. In reality the school is an exchange; the only difference being that the wire with which the pupils will operate will not be directly connected with subscribers' telephones. In the school-room will be desk 'phones. At each of these will be stationed a teacher, who will call a pupil up as a regular subscriber would, so the girls will have the same experience they would get on regular wires.

The pupils will be graduated as soon as they prove themselves skilful enough to take charge of wires at regular stations.

Wants Broad Telephone Bids.

There will be competition over the franchise which San Francisco, Cal., is asked to grant for a competing telephone company.

P. Kerr Higgins, A. M., I. E. E., manager of the United States Long Distance Telephone & Telegraph Company and formerly superintendent of the Home Telephone Company of Los Angeles, writes from the southern city to ask the board of supervisors to make the competition for the franchise sufficiently broad to permit of the installation of the "most modern apparatus," whether it be "manual or automatic."

Mr. Higgins says that he represents an Eastern syndicate with resources of $5,000,000. He is willing to give the names of his backers any time in confidence, and suggests that the supervisors investigate the merits of his telephone at the expense of the successful bidder for the franchise.

An Independent telephone line is being constructed by W. A. Chamberlain, of Constable, N. Y., which already has a considerable patronage. Mr. Chamberlain began the work on his line a year or two ago, confining his operations to the town of Constable. This season he has extended his system, now being at work on an extension to the village of Huntingdon, going by way of Lee's Corners and the Irish Ridge. He has received promises of a liberal patronage in Huntingdon, as the rate is only $12 per year.

The annual meeting of the Jackson County Telephone Company was held at Elkville, Ill., a short time ago. A special meeting will be held November 14 for the purpose of placing a motion for moving the main office from Elkville, to Murphysboro. The following officers were chosen: President, C. A. Schwartz, of Elkville; vice-president, R. H. Blacklock, Vergennes; secretary, John D. Hayes, Elkville; treasurer, Samuel Schwartz, Elkville.

The Valley Telephone & Telegraph Company of Green Bay, Wis., has issued an amendment changing its name to the Fox River Valley Telephone & Telegraph Company, and increasing its capital from $250,000 to $350,000. W. E. Fairchild president, and Joseph P. Hoepfel secretary.

The Southwestern Telegraph & Telephone Company is preparing to build a line from Nettleton to Wynne, Ark.

Independent Companies Connected.

The Ellis County Independent Telephone Company and the Fort Worth Independent Telephone Company of Texas are now in direct communication with each other. Arrangements have been made to establish a long distance service between these places. The completion of this line gives Waxahachie connection with Forth Worth, Gainesville, Sherman and other North Texas points.

The Hayes Valley Improvement Club of San Francisco, Cal., has adopted strong resolutions in favor of the grant of a franchise to the Home Telephone Company by the board of supervisors. The fact is recited in the preamble of the resolutions that the company has agreed to spend $2,000,000 in 12 months, $3,000,000 in two years, and $4,000,000 in three years, thus giving employment to between 2,000 and 3,000 men, and that the company has also undertaken to pay 2 per cent. of its gross receipts to the city. The resolutions pronounce firmly against monopolies, and the club "urgently requests that the honorable board of supervisors grants the application for a franchise to the Home Telephone Company." Reference is made to the imperfections and anoyances of the present telephone system.

The appraisers appointed to place valuations on the personal estate left by the late Simon P. Sheerin, have filed their report with the Probate Commissioners in Indianapolis, Ind., showing an aggregate value of the estate of $298,877.41. The property consists of certificates of stock in the various telephone companies, principally local corporations. The inventory follows: Indianapolis Telephone Company, 1,196 shares, $59,800; preferred stock, same company, 299 shares, $22,425; New Telephone Company, 421 shares, $33,686; New Long Distance Telephone Company, 1,111 shares, $49,995; Citizens' Telephone Company, Columbus, Ind., 611 shares, $18,330; thirty-one bonds, New Telephone Company, $24,800; 33 bonds, New Long Distance Telephone Company of Indianapolis, $28,050; 59 bonds, Citizens' Company of Columbus, Ind., $22,125. Cash in Fletcher National Bank, $8,410, cash in Capital National Bank, $4,915.

Fred B. Jones, superintendent of construction of the Home Independent Telephone Company at Salt Lake City, Utah, has completed a trip through Carbon and Emery Counties with a view of connecting up this section with Sanpete County, and the main line eventually at Salt Lake City. It is said that the Price and Emery County line from Price to Ferron is likely to go to the Home. Whether disposed of or not, it is the intention to extend the present line to the town of Emery and to put in drop switchboards all along the route. The present company also contemplates further improvements and extensions.

Incorporation papers of the Pioneer Telephone Company, which proposes to construct a line serving all the towns of Erie County, N. Y., were lately filed with the county clerk. The capital stock is fixed at $10,000. The directors are C. D. Cramer, O. A. Martin, William Bald, E. Weinanger, H. C. Britting, F. C. Goold and F. W. Schaad. The headquarters are at Clarence.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Albany, N. Y.—The Suffolk County Lighting Company has been formed to deal in gas and electricity for lighting the villages of Suffolk and Nassau Counties. Its capital stock is $50,000, and the directors are George MacDonald, C. A. Hickey and W. Morgan, of New York City.

Columbia, Mo.—This city has voted $10,000 in bonds for improving the municipal electric light and water plants. E. D. Podrick, city engineer.

Concord, Conn.—This city is soon to have practically a new electric light plant.

Greens Farms, Conn.—Superintendent F. B. Hubbell is making a canvass of this place in relation to extending the electric lights here. He says that he finds nearly everyone in favor of the lights and ready and willing to have them put in.

Greenwood, Wis.—The proposition to bond this city for electric lighting and waterworks was carried.

Herington, Kan.—Charles F. Gustafson, of the Topeka plumbing firm of Conklin & Gustafson, has secured a franchise to furnish water, electric light and power to this city.

Hyattsville, Md.—The prospects for the installation of an electric lighting system here, to take the place of the present plant, are exceedingly bright. It is proposed to have the citizens subscribe to a fund to install the plant and have the town create a sinking fund to reimburse the subscribers in the course of four or five years. By this means the town will eventually own the plant.

Kankakee, Ill.—W. J. Brock, W. P. Dixon, Benjamin B. Sammons and Americus E. Melville have been granted a franchise to construct and maintain poles, wires, etc., for lighting, power and heating purposes within the city limits.

Lansing, Kan.—Through the increase in business which necessitates the use of electric lights the merchants of this place have decided to provide themselves with an electric plant.

Midland, Md.—William Borderick, A. A. Davis, Henry Ward and others propose organizing a company to install an electric light plant.

Morrison, Ill.—The Morrison Electric Lighting Company has increased its capital stock from $20,000 to $60,000.

Newport, Ky.—An election is to be held to vote on the question of issuing $50,000 of electric light plant bonds.

Norwalk, Conn.—By a vote of 128 to 42 a special city meeting passed a resolution instructing Mayor Buxton to appoint a committee of three to consider the advisability and to formulate a method of procedure in establishing a municipal electric light plant.

Oliver Springs, Tenn.—This place is soon to have an electric light plant. F. C. and W. H. Sienknecht are very much interested in the scheme.

Paragould, Ark.—This city is arranging to install an electric lighting plant and construct sewers. For information address Jason Light, secretary of the board of aldermen.

Quincy, Fla.—This city has proposed the issuance of $5,000 in bonds for improvement of waterworks and electric light plant.

Richwood, O.—The Richwood electric light plant was lately sold by Edward A. Schambs, of this place, and Col. C. W. Fisher, of Bucyrus, to a local company recently organized for that purpose.

Salt Lake City, Utah.—The Progress Company has been granted a franchise by the county commissioners to string electric light wires from Murray to Bingham Junction for the purpose of furnishing electric lights to the latter place.

Sioux Falls, S. D.—The Queen City Electric Light & Power Company has been incorporated with a capital stock of $300,000 by H. J. Hanford, of Chicago, Pitt Curtis, of Norwalk, O., and A. Huntington, and U. S. G. Cherry, of this city.

Toledo, O.—Charles S. Ashley, president of the Central Heating & Lighting Company, announces that extensive improvements are about to be made in the electric lighting plant.

West Branch, Mich.—W. W. Vaughn sold the Rifle River Electric Light & Power Company to the Eddy Company of this place, instead of having purchased it, as was stated in the issue of ELECTRICITY for August 23. Mr. Vaughn is now constructing a plant on the Sturgeon River to light several villages along the Michigan Central Railroad.

Westfield, Wis.—The vote to establish an electric light plant in this village was lately carried.

STREET RAILWAYS.

Albany, N. Y.—The Elmira, Corning & Waverly Railway of Elmira has been incorporated with a capital of $2,500,000 to construct an electric road 37 miles long. The directors are Senator William J. Tully, of Corning; G. Tracy Rogers, of Binghamton; A. N. Brodhead and Arthur C. Wade, of Jamestown; Joseph A. Power and James H. Caldwell, of Troy; Thomas O'Connor, of Waterford; Frederick E. Hawkes and William L. Watrous, of Waverly; George McCann and A. Lee Smith, of Elmira.

Alliance, O.—The promoters of the new electric line from this city to Akron have decided to ask for a charter under the name of the Alliance-Akron-Cleveland Company with a capital stock of $50,000. Hugh Bleakly is the organizer.

Bucyrus, O.—An enthusiastic meeting was lately held at New Washington for the purpose of considering the building of the Bucyrus, New Washington and Chicago Electric Line, which it is proposed to run from Chicago Junction through New Washington and Sulphur Springs to this city.

Cedarville, N. Y.—A meeting was held recently for the purpose of granting a franchise in this village to the new proposed trolley company.

Cincinnati, O.—A great trolley system from here to Pittsburg is planned for the near future.

Davis, I. T.—The city council in an extra session granted a franchise through the streets to the Oklahoma City, Lexington & Sulphur Springs Electric Railway Company.

Greenwood, Miss.—Interest is being revived in the proposed electric railway for this city. The Greenwood Electric Railway Company will begin the construction of the road before its franchise expires.

Hoopeston, Ill.—The Interstate Traction Company has increased its capital from $100,000 to $500,000.

Jefferson City, Mo.—The McKinley Syndicate is about to build an electric line from Carthage to this city.

Long Beach, N. Y.—Trolley connections between this resort and Point Lookout, its eastern extremity, is confidently expected to be a reality next season.

Marion, O.—Another electric line is being projected to this city.

Monett, Mo.—The city council lately passed an ordinance granting a franchise to C. W. Copeland and others, for the purpose of constructing and operating an electric car line over the principal streets of this city.

Peru, Ind.—The directors of the Peru-Winona electric line have decided to start work immediately on the new road. Captain Duke is interested.

Rochester, N. Y.—Plans are now being discussed for a belt trolley line to take in some of the more important towns south of this city and along the river. Isaac W. Salyerds, of Scottsville, is interested in the project.

Springfield, Ill.—Ground was lately broken for the new electric interurban railway to be built between this city and Petersburg.—The Secretary of State has licensed the St. Louis, Vandalia, Terre Haute & Eastern Traction Company, capitalized at $1,000,000, incorporated by B. Chase, of Decatur, and Charles W. Mills, of Chicago.

Syracuse, N. Y.—The Auburn & Syracuse Electric Railroad Company contemplates increasing its capital stock from $1,500,000 to $2,000,000.

Yorkville, Ill.—An electric line is to be built from here to Morris.

POWER PLANTS.

Fayetteville, Tenn.—A number of local capitalists are interested in harnessing Elk River so as to utilize the power which has been wasted for years. They propose to place a dam across the river near Pearl City, a few miles below this place, and will erect a $60,000 cotton mill. The Elk Cotton Mills of this place propose to float the bonds.

Harrisburg, Pa.—The Pennsylvania Traction Company will erect a new power plant to cost from $200,000 to $250,000.

Huntingdon, Pa.—The Juniata Electric Company, a new corporation, contemplates spending $750,000 in building a dam across the Juniata west of this place, and erecting a great power plant here for the purpose of furnishing electric light for all the manufactories of Altoona, Tyrone, Huntingdon and intermediate towns in the Juniata Valley.

Joliet, Ill.—A power plant is to be erected here by the Illinois Steel Company of Chicago, to cost $1,000,000.

Marinette, Wis.—The Penn Iron Mining Company has started work on a power plant at the mouth of the Sturgeon River at the junction with the Menominee. The dam will be finished this year. Nearly 4,000 hp. will be generated and will be used to operate the machinery in the mines of the company at Norway, Mich.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 16½@16¾c.; Lake 16½@16¾c.; casting, 16¼@16⅜c.

The quarterly rental of 1¾ per cent. on New York Metropolitan Street Railway stock will be paid October 15.

The annual report of the Brooklyn Rapid Transit Company is ready for submission to the members of the executive committee, and will show, it is said, the greatest earning power ever displayed by the system.

The Chicago Electric Traction Company, which is now in the hands of a receiver, is to be taken out of litigation and absorbed by the Chicago & Southern Traction Company, a new Indiana corporation, which is capitalized for $2,000,000.

A point that seems not to have been made public before, in connection with the Keystone Telephone Company's financing, is that the preferred stock may be retired, under certain conditions, and that $2,500,000 of the new bonds are reserved for this purpose.

There has been a shrinkage of over $45,000,000 in the selling prices of copper shares between the high prices of this year and the low prices of Saturday. There has been no reduction in the commercial price of copper, nor are there any immediate signs of any, and yet copper stocks have declined materially.

A trust mortgage of $5,000,000 has been given by the Grand Rapids-Muskegon Water Power Electric Company to the Michigan Trust Company of Grand Rapids to secure an issue of bonds at 5 per cent. interest, the bonds to be issued in denominations of $100 each, and the principal and interest to be paid in gold.

President Mellen, of the New York, New Haven & Hartford Railroad Company, has made a voluntary increase in the wages of motormen and conductors on the Consolidated Railway system, which is owned by that company. The increase is one cent per hour and the new scale went into effect on Monday.

A director of the Philadelphia Electric Company in discussing the electric lighting situation in his city repeats that any published lists of other cities where lighting may apparently be done at a cheaper figure are incomplete unless they include such information as costs of coal, free lights, all-night schedule, etc. As a general proposition, he contends, it costs more for lighting in the larger cities than in the smaller ones.

Owing to the change in the termination of the fiscal year of the Allis-Chalmers Company, from April 30 to June 30, no exact comparison may be made between the annual report issued on Saturday last and the preceding report. The report for the fiscal year ended June 30 last states that the capital stock remains the same as in the previous year, as follows: Authorized common stock, $25,000,000; authorized preferred stock, $25,000,000; total amount authorized $50,000,000. The outstanding share capital is as follows: Common stock, $19,820,000; preferred stock, $16,150,000; total amount outstanding, $35,970,000. The net profits for the fiscal period ended June 30 last, after deducting all expense of manufacturing and selling and after making provision for the depreciation of buildings and machinery and for possible bad debts, amounted to $68,982, as compared with $952,624 in the fiscal year ended April 30, 1904. In the latter year dividends of 5¼ per cent. were paid upon the preferred stock, amounting to $853,125, leaving a surplus of $99,499.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price Sept. 2
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	217
Manhattan Elevated Railway	164¼
Metropolitan Street Railway	128⅞
Metropolitan Securities	82½
Ninth Avenue	197
Third Avenue	128
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	68¾
Brooklyn City Railway	239
New Orleans Railway	36½
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81¾
Philadelphia Traction	101
Union Traction	61⅝
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	19½
do. do. do. pref	81
West End Street, com	97½
do. do. do pref	113
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	8½
do. do. pref.	37
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	16
do. pref.	58
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	18
do. do. pref.	23
Westinghouse, com	170
do. pref.	190
General Electric	180
Boston.	
Edison Electric Illuminating	256
General Electric	180
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	155
National Carbon, com	60¾
do. do. pref.	115½
Philadelphia.	
Electric Company of America	11½
Electric Storage Battery, com	84¾
do. do. do. pref.	84¾
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	140¾
Western Telephone Company	16
New England Telephone Company	134
New York.	
American Telegraph & Cable Company	190½
Commercial Cable Company	210¼
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	94⅛
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Chicago Subway	84
Otis Elevator Company	62
Standard Underground Cable	..
Twin City Rapid Transit	115½

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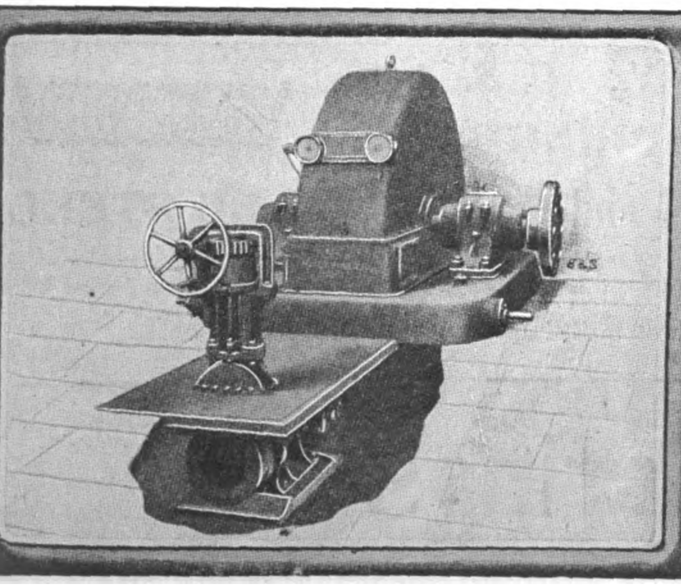

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ELECTRICITY.

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EDITORIAL NOTES.

Elementary Considerations. Fuses are simply pieces of metal alloy in the form of bands or wire, which connect the circuit with the source of power. It seems as though the fuse question would be apparent from any standpoint whatsoever. At any rate, certain elementary considerations can be touched upon for the purpose of discovering why such doubts, as are sometimes expressed with regard to their operation, have a good foundation.

A metal alloy of this character is only made up for the purpose of obtaining volatilization when a certain temperature is reached. For the further success in accomplishing this purpose, fuses are made to melt or volatilize with a certain current. This is where the difficulty occurs. Any piece of wire is subject to the influence of temperature under such peculiar conditions. A piece of fuse wire, melting at its correct amperage, would not perform its function properly in a region exposed to Arctic cold. On the other hand, within the Torrid belt, the abnormal heat would make it melt all the sooner. The question, therefore, of why fuse wire betrays such irregularities. is best answered by the remark that the irregularities, if any, are the result of periods of high and low temperature. A fuse up near the ceiling is affected by a blanket of hot air. A fuse further down, or in a cold hall, is really one capable of standing a heavier current. Although the point at which a fuse blows is predetermined, it is not to be forgotten that this point is only correct for a certain external temperature. If a fuse is erratic, in that it cannot be depended upon, then the metal is at fault. But until this is ascertained, the heat and cold are reasonable answers to all such questions.

Reasons for Successful Manufacturing. The intertwining of shop methods with business rules has resulted in a sweeping reform in processes of manufacture. The difference between American and European systems in this respect has excited wonder and comment. From amidst all the possibilities pertaining to the complications of the manufacturing art, the genuinely thorough and practical scheme of operation has been selected and adopted in all large shops and factories of the United States. One of the best reasons why successful manufacturing has been the keynote of our commercial progress is because, either through knowledge or instinct, the organizers of large manufacturing plants have developed remarkable methods—the only methods—by which cheapness and dispatch can be secured. In the development of the electrical industry events occurring within our own time have left their traces upon the present processes in vogue. In the beginning the manufacture of electrical appliances belonged to the sphere of work controlled by the maker of physical and laboratory devices. The dynamos to be obtained were hand magnetos, the motors merely toys, and the other class of apparatus only that commonly accepted by lecturers and students as serviceable for purposes of demonstration. Even in the creation of these appliances a rather haphazard method of manufacture prevailed. The man of the shop, or rather the most valuable men of the shop, were those possessing a peculiar skill in obtaining results from the devices they made. The ruling power was an arbitrary one, and the actual operation of a magneto or motor, supposed in a sense to result from a certain knack in the fingers of the builders, was therefore considered as resulting from an unusual exhibition of personal acumen. In other words, shop methods of the old school were cases of where the skill appeared only in spots. A few were the possessors of this rare qualification, and they dominated, as far as the rate of production was concerned, in all cases where this peculiar system prevailed. Even to-day, in some fields of work, where individual skill is the sole asset, the art is handed down from father to son for generations. There is no publicity given either to the art or method.

The elements from which spring such remarkable abilities are, as far as the owners are concerned, hidden from analysis. General progress on a large scale for this reason could not take place. Its appearance occurred only in certain directions. This was particularly true in the manufacture of electrical apparatus and machinery. At one time the art of coil building was possessed by very few. At another time the operation as well as the construction of a dynamo was shrouded in mystery. Lamp making belonged to a chosen few both in its methods and testing. But individual skill and knowledge have been systematized, written up, and taken out of the shop for others to know. As a result, the shop expanded, and with this expansion came the crystallization of certain principles.

Cheap and successful manufacturing is a success, because thousands now possess the skill at one time only in the hands of a few. Machines do the thinking and acting in turning out products with which a million men would unsuccessfully compete. This is one of the best reasons why America leads in the manufacture of electrical appliances.

* * *

Politics and Municipal Ownership.

There seems to be a desire on the part of the "bosses" of the leading political parties in Greater New York to "make a play" for municipal ownership at the November elections. The "Wall Street Summary" says that the statesmen (?) who are advancing the general proposition are dragging it before the public by the horns and with all the strength they can exert, for, as a matter of fact, there has been no general or insistent demand upon the part of citizens of New York for any such radical change. Practically the only city of the first importance in the United States that has considered this question seriously is Chicago, and even there the agitation in favor of it is in such an inchoate state that even the most vigorous advocates of it must be seriously discouraged. The municipal ownership proposition obviously is one of such great importance to everyone, even the humblest member of the community, that we should not be asked to pass upon it until after a protracted and exhaustive examination and discussion. At the moment, if we read the temper of our fellow-citizens correctly, they are pretty well satisfied with the existing order of things. It is not conceivable that the city could manage or operate our systems of local transit any better than they are being operated by private enterprises, or could supply the public with transportation at lower rates than rule at present. The same is true of gas and electric light service, the prices for both of which have been declining steadily for some time past, yet without any impairment of the quality and quantity of the products furnished to the public. Anyone who has ever come in contact with the rank and file of the city officeholders must shudder to think of the treatment he would receive if all of our street car employes were appointees of the party in power, no matter which party it might be, or of having to depend upon the same class of employes in dealing with their requirements in other respects which are now supplied by privately owned corporations. Is it inconceivable that an insolent or incapable street car conductor or motorman would, with his political pull, receive the same treatment from a superior municipal officer that he now gets from corporations that are intent upon raising the efficiency and courteousness of their employes to the highest possible degree.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

President Blood of the National Electric Light Association has appointed the following gentlemen as the committee on standard rules for electrical construction and operation: Ernest H. Davis, chairman; Capt. William Brophy, Louis A. Ferguson, Alex. Dow and Samuel Scovil.

A cable dispatch from St. Petersburg, September 9, says that an imperial ordinance will shortly be published providing for the abolition of retaliatory duties on machinery from America.

The eighth general meeting of the American Electrochemical Society will be held at South Bethlehem, Pa., Sept. 18, 19 and 20. The first session, next Monday, will commence at 3 P.M., while the sessions on Tuesday and Wednesday will open at 9 A.M. The meetings will be held in the lecture room of the Physical Laboratory of Lehigh University.

Twenty-four electric traction companies are now in operation in Indiana with a total of 913 miles. All of those railways have been built in the last ten years.

The electric light plant of Osaka, Japan, a city with 800,000 population, has been entirely equipped with American electrical apparatus.

The wireless telegraph station on Anastasia Island off the coast of Florida is now complete, and was officially placed in commission a short time ago.

Since the advent of the electric sign in Boston the amount of electric current consumed there has had such a notable yearly increase that its figures are really astonishing. Now that the figures are compiled Boston claims to lead the world in consumption of electric current per capita.

The mule tramway lines in Para, Brazil, are to be electrified.

The Western experiment of trolley sleeping cars has, it is said, enlightened certain capitalists interested in the development of a through trolley line from New York to Boston. It is stated that when the links between the various trolley lines now in use between this city and Boston have been connected that sleeping cars with all the conveniences of a regulation Pullman car at about half the price may be looked for.

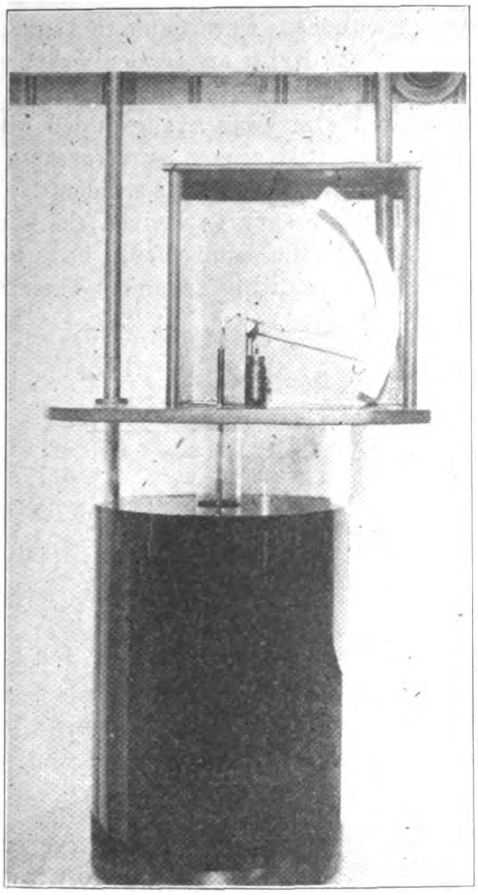
In a short time tests will be made to establish direct wireless telegraphy between Washington, D. C., and the navy yard at Brooklyn, N. Y. Hitherto messages have been sent between the two places by relays, but it is thought this can be improved upon.

The construction of an electrical high-speed railway between Cassel and Cologne, Germany, is suggested by Mr. Frankel, a Breslau engineer, with a view to testing on a large scale the possibilities of electrical long-distance railways. Assuming a maximum speed of 160 km. per hour, corresponding with a commercial speed of about 125 km. per hour, the electrified Cologne-Cassel line (180 km.) could be traversed in 1 hour and 27 minutes, while 5 hours are required to cover the present line of 275 km. length passing through Elberfeld.

A NEW EUROPEAN HIGH POTENTIAL ELECTROSTATIC VOLTMETER.

BY FRANK C. PERKINS.

A most interesting electrostatic volt meter has recently been designed by Prof. August Grau, of Vienna, Austria, for measuring potentials up to 90,000 volts. This electrostatic instrument, noted in the accompanying illustration and drawing, consists of a glass jar filled with oil, which is used as a dielectric, with a glass plate resting on three supports at the bottom. A metallic cylinder is supported on this plate, forming one plate of the voltmeter, the connections being made to this cylinder by a wire placed in a porcelain tube passing through the oil. A smaller cylinder is utilized concentric with the larger cylinder suspended by a copper wire surrounded by a glass tube. A thin plate is attached to the lower end of this small cylinder with a lead weight under the plate. A glass rod is utilized projecting from the weight to hold the movable system, which is concentric with the large fixed cylinder. As will be noted by the illustration there is a fine wire passing over a pulley connected with a counterweight, the pulley having the pointer attached to it and multiplying the motion of the cylinder, which moves up and down, the proper reading being indicated on the scale shown in the drawing. The other side of the high-potential circuit is connected to the movable system, the conductor passing to the pulley through a porcelain tube, while in order to damp the motion of the movable cylinder a plate is fastened to the lower end of the same. There are three friction rollers fastened to the glass plate which hold the glass rod in position, the latter passing through an opening in the plate. This electrostatic voltmeter is constructed for 90,000 volts and cannot be utilized at higher pressures, as in so doing there would be a discharge through the oil between the plates.



An Electrostatic Voltmeter.

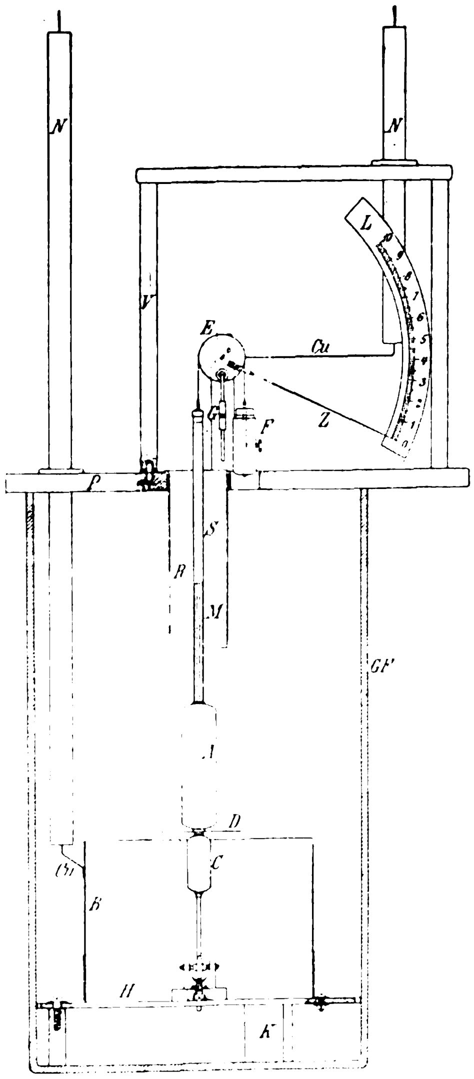


Diagram of an Electrostatic Voltmeter.

There has been considerable difficulty in measuring high pressures, many types of instruments being utilized which give satisfactory results up to 25,000 volts. It is claimed that accurate readings are obtained by using a transformer in the high voltage line if all leakage is prevented, and if non-inductive resistances are employed, which are reliable, they may be utilized to advantage as multipliers. Other high tension instruments have been designed with condensers in series, employed as multipliers; but difficulties have been encountered due to various frequencies employed, it being hard to make an instrument with the same dielectric coefficient as the condenser.

The voltmeter shown in the illustration has given excellent results and has a capacity of about .0001 microfarad. The large cylinder is 140 mms. high and 200 mms. in diameter, while the smaller cylinder, which is movable as seen in the illustration and drawing in the center, is 110 mms. long and 30 mms. in diameter, while 200 grams is the weight of the lead attached to the same. There should be a wide field of usefulness for the electrostatic voltmeter in measuring the pressures of high tension power transmission lines and apparatus.

ELECTRICITY AND PLANT GROWTH.

The "Electrician," London, publishes some statistics on the effect of electricity on plant growth, as given by a correspondent in "The Fruit Grower and Market Gardener," that are to say the least very interesting. The experiments in question were made at Bristol, England, the method employed being that advocated by Prof. Lemstrom. The communication is as follows:

You will see that the hopeful views I expressed in April have in the main been justified. Taking the experiments where the crop has already been secured, the results have been:

Cucumbers, 17 per cent. increase; strawberries (five-year plants), 36 per cent. increase; strawberries (first-year plants), 80 per cent. increase; broad beans, 15 per cent. decrease but an acceleration of about five days; cabbages, acceleration of about 10 days. . . . On May 8 the spot disease appeared in the cucumber houses, and attacked the unelectrified worse than the electrified houses, and how much of the increase is due to the direct influence of the electricity and how much to the lesser virulence of the disease in the treated houses must remain an open question, to which further experience alone can give the answer. The increase in either case remains to the credit of the electric treatment, for it is difficult to avoid the conclusion that it was a preventative (though not an absolute one), as during a week in which the influence machine was not at work the disease made headway in the electrically-treated houses.

It is an interesting fact, and bears on the question, that we have indications that electricity also operates against macrosporium tomato, but the data are as yet insufficient to let one speak positively.

The increase in the strawberries is remarkable (though Lemstrom records even greater increases), and as far as I know there is no factor other than the use of electricity which will explain it. A far greater number of runners have been produced from the electrified plots. Current was first put on March 24. All plants flowered together, and there was no marked acceleration of the ripening of the berries. Whether the increased weight be due to a larger number or a greater size of the berries per plant I cannot say. I am inclined to think both causes operated, the latter more than the former. The total area of the experimental and control plots amounted to rather over 1,000 square yards.

The result from the beans confirms Prof. Lemstrom's experiment. There was apparently an increase in the tops, but these were not weighed. The cabbages were cut from the electrified half about a week to a fortnight before the non-electrified, and, on the whole, hearted better. It must be borne in mind that these were spring cabbages, and that the same result need not necessarily follow with summer cabbages when the ground is drier, and also that as the current was only applied for about half the growing life of the plants, and then only about four hours daily, a greater acceleration might have followed a larger use of the current.

The tomato crop is not, at the time of writing, finished, but is far enough advanced to show that the current has exercised no appreciable influence. In the earlier stages a quicker growth was observed, but the advantage gained was not maintained. As the tomatoes are grown in cucumber houses, there is very little room to run the distributing wires, which have to be close against the roof, and possibly the greater portion of the current gets to earth via the roof and house wires without doing useful work. This is a point I hope to investigate when opportunity offers. I have already mentioned that there is some evidence of disease being checked. This, it may be worth while to point out, is probably caused by the various gases (ozone, nitrous acid, etc.), generated by the electric discharge operating by keeping the air purer and perhaps sterilizing the pores of the disease.

The electrical part of the installation has throughout given little trouble, and is easy to manage, some care in keeping the wires clear of cobwebs, old tendrils, shoots, etc., being all that is wanted.

Since March 7 the influence machine has been run 1,268 hours, on 108 days out of a possible 136, or an average of 9.3 hours daily. Before May 20 the machine was running in the daytime and evening, since then chiefly at night.

WIRING FOR LAMPS AND MOTORS—MEETING AN EMERGENCY.

BY W. H. WAKEMAN.

ARTICLE II.

Again referring to Fig. 2 the positive wire 12 is spliced, thus making both upper and lower bus bars positive, while the central bar is negative. Current from these bus bars supply two three-wire lighting systems, as shown at the lower part of the figure. Each of them supply three junction boxes, from which two-wire circuits are laid in the usual way. (See Fig. 1.)

These six boxes use about all the current that the dynamo should generate, but the wires, 14, 15 and 16, were added afterward, carrying nearly as many lamps as both of the lower circuits, with the understanding that not all of these lamps would be required at any one time. There came a time, however (as I expected), when they were all wanted at once for a few hours only.

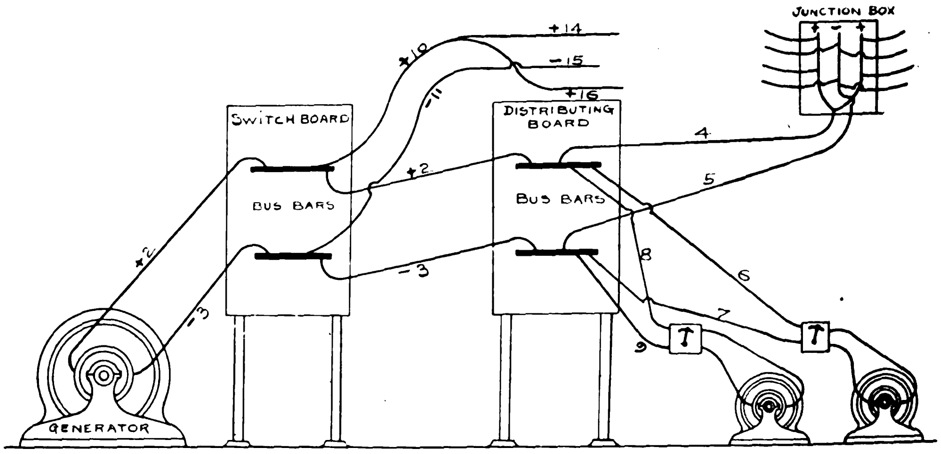


FIG. 3.

Now the generator was not loaded to its full capacity, therefore if some lamps could be taken off from the dynamo lines and connected to the generator the problem would be solved, but something had to be done quickly or important plans on the part of others would be frustrated.

The wires 14 and 16 were spliced and connected to 10, as shown in Fig. 3. Wires 15 and 11 were spliced, thus relieving the dynamo, as illustrated in Fig. 4, which disposed of all trouble so far as this part of the plant is concerned.

The next point to be settled was whether the generator could carry the load called for by the arrangement of wires shown in Fig. 3. When first put on it was well within the limits of its capacity, but as lamps, wires and motors began to slowly increase in temperature, thus offering more resistance, the ammeter pointer indicated but 10 amperes less than the limit, showing that something must be done quickly. The limit in this case was determined by a circuit breaker, which was something more than an ornament, as it would break connections when the proper time came for it to operate.

In other places I have had charge of engines in plants which supplied current for street lights, stores and for private use, where it would cause much annoyance and trouble if the supply should be shut off for any reason, but it seems as if the consequences were liable to be much worse where lights are suddenly shut off from public buildings in which several floors and stairways are crowded with visitors, as it is almost sure to cause a panic, resulting in serious accidents.

It was necessary to reduce the load, but none of the lamps could be turned off without causing trouble. These 20 hp. motors are used to drive large fans for ventilating purposes, therefore it was practical to reduce their speed, which of course would take less power.

There is a right and wrong way to do this, for if the starting lever is thrown back carefully, one notch at a time, the change will hardly be noticed by people who are using the lights. (See Fig. 5.)

On the other hand, if it is thrown back quickly, four or five notches, the lights will show it at once, and as every such imperfection in service is charged to the engineer by the general public, whether it belongs to him or not, it is a good idea to watch these details and have as few explanations to make as possible.

There is at least one other reason for handling all such matters with care, and a very important one, too, as follows. Any sudden change in the call for current may lower the voltage on over-compounded generators and dynamos, and as large fans or other machinery driven by motors will accumulate much momentum one or more of them may act as a prime mover for its particular driver for a short time, but it may be long enough to actually drive the motor, thus converting it into a generator and reversing the polarity—drawing a heavy charge from the main generator—which will throw out the circuit breaker, leaving all rooms and halls in darkness.

In this case the speed of motors was reduced without trouble, thus reducing the amperage until it was within safe limits, even when a higher temperature had increased the resistance.

If the voltage is reduced the amperage will also be less even with the same number of lamps and motors in use, but where this method is tried it must be done very cautiously as otherwise the polarity will be reversed as previously described. This refers to a system including lamps and induction motors. It may apply to other systems, but I know it does to this.

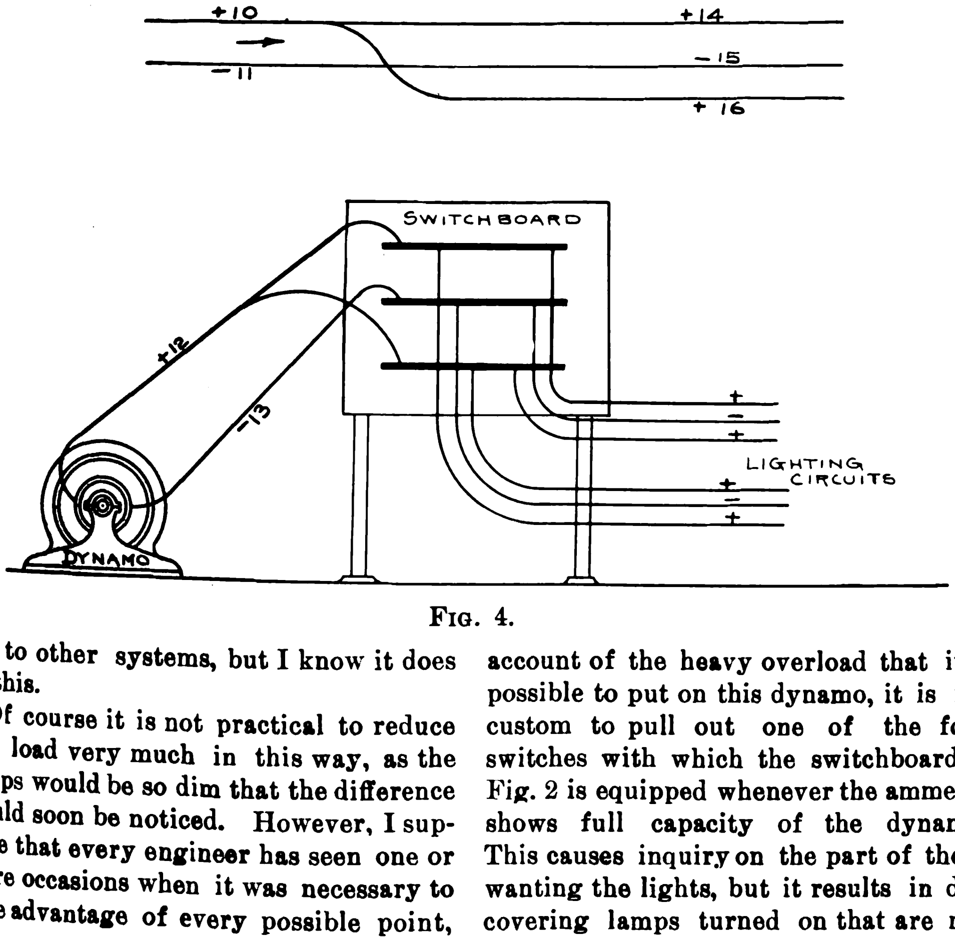


FIG. 4.

Of course it is not practical to reduce the load very much in this way, as the lamps would be so dim that the difference would soon be noticed. However, I suppose that every engineer has seen one or more occasions when it was necessary to take advantage of every possible point, either great or small, in order to prevent shutting down, consequently every suggestion along this line will be useful sooner or later.

Nearly every advertisement of a generator or motor states that it will stand an overload of 100 per cent. for a short time, and that it will carry from 25 to 50 per cent. overload for several hours. The proviso that it will carry 100 per cent. "for a short time" should be taken literally for the time must be very short. Perhaps it will carry 25 or even 50 per cent. for an hour or two, but I have never met even an enthusiastic salesman who claimed that it would do the machine any good, while many engineers and electricians testify to the contrary.

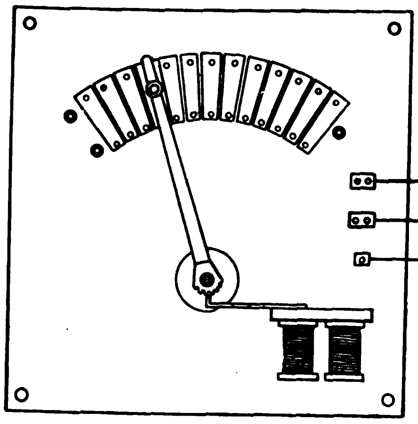


FIG. 5.

As the change made in this system of wiring was only for temporary use, it was replaced as originally shown. On account of the heavy overload that it is possible to put on this dynamo, it is my custom to pull out one of the four switches with which the switchboard in Fig. 2 is equipped whenever the ammeter shows full capacity of the dynamo. This causes inquiry on the part of those wanting the lights, but it results in discovering lamps turned on that are not needed, and when these are turned off the remainder does not constitute an overload. I consider this much better than to heat the dynamo until it must be stopped.

In these articles the term "generator" and "dynamo" are used to describe machines that supply the same kind of current, which at times is used for exactly the same purpose. This is done in order to distinguish them in several descriptions necessary to a full understanding of the matter.

In common practice a machine tha supplies current for driving stationary motors, or those located on street cars, is called a generator, while one that furnishes current for incandescent or arc lamps, or perhaps for both, is called a dynamo. Both of these types may be divided into several kinds according to the nature of current generated, therefore when speaking or writing of an electric machine it is well to state briefly what it is intended to do.

Illustrating this and referring to Fig. 1, it would be called a 10 pole, 125 volt, direct current generator. For Fig. 2 it would be a 4 pole, 125 volt, direct current dynamo. They are made to carry 125 volts in order to provide a margin over what is actually necessary to give 110 volts at the lamps.

THE ARTIFICIAL LIGHTING OF SCHOOLS.

A recent number of the "Zeitschrift fur Beleuchtungswesen" contains an interesting aeticle written by Dr. J. J. C. Muller, of Bremen, describing the experiments he has made in certain high schools of that town upon the proper arrangement of the artificial lights, so as to secure full illumination upon the students' desks. At the outset, a rule was laid down that the strength of the illumination at all points in the room should be at least 2.04 candle-feet.

The first experiments he describes at length were carried out in a room 25 ft. 3 in. long × 23 ft. wide × 13 ft. 3 in. high. It was stripped of all furniture and fittings, and the walls and ceiling were given a fresh coat of lime wash. The source of artificial light consisted of four groups of "Tantalum" electric glow lamps, each group containing six lamps of 22 cp. arranged under a reflector of mirror glass. The positions for the lighting groups were found by dividing the room into four equal rectangles, and then hanging each group as nearly as possible from the point given by the intersection of the diagonals of the said rectangles. The amount of energy consumed by the lamps was about 1,080 watts, and they were provided with ground-glass globes. The benches ordinarily used in the room were 2 ft. 10 in. high. Measurements of the illumination afforded were made (1) with the lamps 6 ft. 6 in. above the desks, (2), with the lamps 8 ft. 3 in. above the desks, and (3) with the lamps close to the ceiling, i. e., 10 ft. 4 in. above the desks. In the first case the illumination varied from 5.5 to 3.4 candle-feet, in the second from 4.8 to 3.5 candle feet, and in the third from 4.2 to 2.9 candle-feet. In order to see the effect of the reflection from the walls, two sides of the room were next almost entirely covered with blue photographic prints, the lights being in the second position. Measurements of the illumination in the same spots as before gave readings of from 4.6 to 2.8 candle-feet. Then several rows of benches 2 ft. 4 in. high were brought into the room, and three scholars placed at each of them, the lights being 8 ft. 10. in. above desk level. The illumination was found to range from 3.8 to 2.7 candle-feet, one spot having only 2.3 candle-feet, but probably this was in shadow. As a result of his experiments the author concludes that such a system of direct lighting by means of four groups of six 22 cp. glow lamps with matt globes and mirror reflectors placed at a height of from 8 to 9 ft. above desk level gives a sufficiently bright and uniform light for a room of the size in question, even when allowance is made for the gradual soiling of the walls and ceiling, and the diminution in illuminating power of the lamps themselves. The illumination at writing level is not likely to fall below the 2 candle-feet required.

The next series of experiments were carried out upon indirect lighting by means of arc lamps. The room used was 34 ft. long × 24 ft. 3 in. wide, freshly whitewashed as in the former case. Two Siemens-Schuckert school lamps for indirect lighting were employed, slung approximately from the longer diameter of the hall about 8 ft. from either end of wall, i. e., about 18 ft. apart. The lamps required 10.4 amperes of current, and absorbed 1,144 watts. They were fitted with metallic reflectors, which threw all the light upwards on to the ceiling and on to a strip about 4 ft. wide at the upper part of the walls. Measurements were then made in the empty room of the illumination at bench level. The values obtained ranged from 4.7 to 2.5 candle-feet in some 15 different situations and it was found that the two lights would be more advantageously placed if 23 ft. apart instead of 18 ft. The room was then filled with its complement of eight double school benches of three seats each, and the places were filled up with grown men. Measurements of the illumination were made in 32 places, between each of the supposed students. The values obtained varied from 2.3 to 1.6 (in one spot only 1.45) candle-feet, and it was evident that the light was very uniform in spite of the living obstacles to its equal distribution. If the separate desks used in higher grade schools had been put into the room instead of the forms belonging to elementary schools, the scholars would have been further apart, and the illumination would probably not have fallen below 2.3 candle-feet at desk level. This would have left a sufficient margin for loss of reflective power as the walls and ceiling became dirty to insure a permanent illumination equal to the necessary 2 candle-feet.

It is interesting to observe that the direct incandescent electric light, which gave an illumination at working level equal on the average to 4.1 candle-feet in the first school room when empty, gave only an average light equal to 2.85 candle-feet when the room was fully occupied with benches and scholars, i. e., it suffered a loss of about 30 per cent. The indirect arc light employed in the second hall gave a strength of illumination equal, on the average, to 3 candle-feet in the empty room, which fell to 2 candle-feet when the room was filled. This loss was equal to about 33 per cent. Shadows were distinctly noticeable under the direct light, but were almost entirely absent from the indirect illumination.

Tests were also made of the illumination afforded by a single 10.4 ampere indirect arc lamp in the smaller room mentioned above. It was found that the light was everywhere below the minimum of 2 candle-feet, ranging, in fact, from 1.7 to 1.1. To light such a room properly with indirect arc lamps, one of 15 amperes would be needed, or two of 8 amperes. The latter plan would be preferable in most cases, because at the usual pressure of 110 volts two arc lamps must be put in series.

It will be noticed that, using Tantalum lamps consuming about 2 watts per candle, the power used in the two cases was about the same. If, however, ordinary carbon filament lamps had been employed they would have consumed twice as much power as the inverted arc lamps. Further, the lighting, in effect, would not have been so good, for the pupils of the eyes would contract in presence of the exposed glow lamps globes, whereas with the indirect lighting this would not occur.—"Electrical Review," London.

FRENCH ELECTROMOBILES FOR POSTAL SERVICE.

BY C. L. SMITH.

In the latter part of October, 1904, there was put in service by the Postal and Telegraph Department of Paris 15 electromobiles for use in carrying the mail between the various branch offices and railroad stations and the Central Post-office. Of these 15 cars 12 are to be used regularly and 3 held as a reserve. These cars, one of which is shown in Fig. 1, were constructed by the well-known firm of Chas. Milde & Co. of Paris. They have a large box in the rear with a flap door behind, the box having a capacity of 1.5 cubic meters.

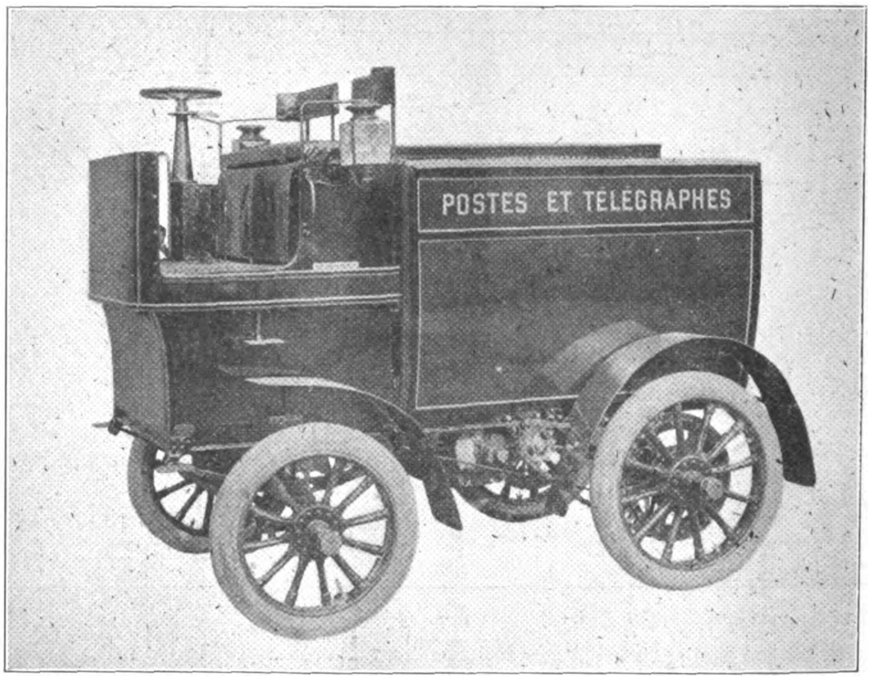


Fig. 1.—French Postal Electromobile in Use in Paris.

The accumulators consist of 44 elements of the Heinz type of 150 ampere hours, and are contained in a case situated under the driver who sits on an elevated seat in front. The case holding the accumulators weighs 650 kilograms.

The electric motor is placed at the center of the chassis and drives the rear wheels by chains. A charging station has been installed in the central building and from noon to 4 o'clock the cars can be charged, each car taking five minutes for the operation. They then continue in service for 10 hours, each charge being sufficient for a distance of from 40 to 45 kilometers.

The electromobiles were required to make a speed of at least 18 kilometers per hour, and they have attained speeds of more than 25 kilometers per hour.

The controller has eight forward speeds and three backward speeds, thus enabling the driver to take the speed of the vehicle in front of him without constantly cutting off the current. A small pedal under the right foot of the driver controls the brake while one under his left foot cuts off the current. The rear wheels measure 920 mm. and the front ones 820 mm., while the wheel base measures 1.6 meters. The weight of the car when empty is 1,800 kilograms.

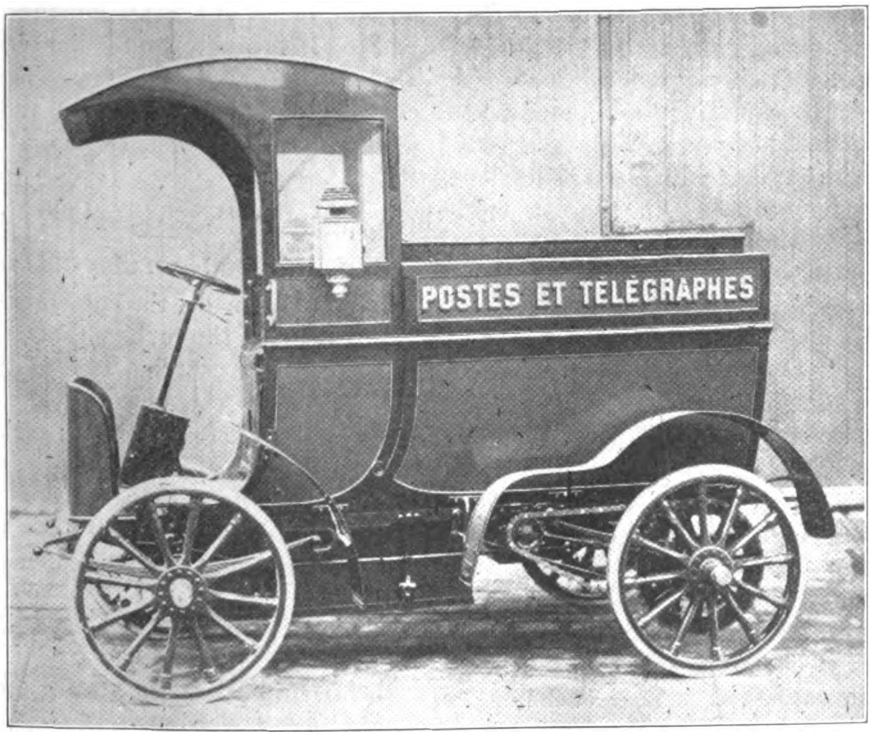


Fig. 2.—Another Type of Electromobile Used for Postal Service.

These motor cars, a new type of which is seen in Fig. 2, have given excellent satisfaction, and it is stated that the system will be extended.

Messrs. Camona, Giussani, Eurinelli & Co. have also constructed a new type of electric mail van, which is in use in Milan, Italy. It is fitted up inside like an ordinary postoffice and has special heating and ventilating apparatus, the ordinary daily run being 16 miles. The car, which weighs about 2,500 pounds, is equipped with two motors, capable of driving it at the rate of 16 miles per hour, the driver standing in front. This mail van has also given satisfaction.

ELECTRIC POWER IN GERMAN COAL MINES.*

In an interesting paper read before the Mining Institute of Scotland, Mr. E. O. Foster Brown describes some of the electrical power installations at German collieries.

Of the three principal coal mining districts, Westphalia, Silesia and Alsace-Lorraine, Westphalia appears to have made the greatest strides in experimenting with and applying electricity for mining purposes, although, in the author's opinion, the conditions prevailing there appear to be scarcely as favorable for its adoption as in Silesia. In Westphalia the seams are fiery, but boiler coal is of much greater value than in Silesia, so that any saving of power is an important economy, and there is also probably more capital available for expenditure on new plant in that district.

The system of current used for general purposes at all of the newer plants is, with rare exceptions, three-phase. "The central power houses of the newer plants are well built and roomy, and fitted up in some instances on a most lavish scale." Whilst no doubt it is very nice to have engine rooms well fitted up, to do so on a "lavish scale" is scarcely what an English engineer would care for; he would no doubt prefer to spend the money over the machinery. Power houses are no better with stained glass windows and beautiful tiled walls and floors.

At coking collieries there is a tendency to take gas from the ovens, which after purification is used to drive gas engines; and it is stated that the power generated by this method, as compared with that of burning the gas under the boilers and generating electricity by the steam so raised, is rather more than double.

The voltage varies very much with the conditions; for three-phase current it is not, as a rule, less than 1,000 volts; usually it is 2,000 or 3,000 volts, and sometimes 5,000. Continuous current does not, as a rule, exceed 500 volts. The three-phase high pressure current is, in the majority of cases, transformed down to 200 or 300 volts at the motor.

The purposes to which electricity is chiefly applied may be stated roughly, in their relative importance, as: Pumping, ventilation, winding, haulage, coal-cutting and air-compressing. With regard to pumps, the tendency in plunger pumps is to increase the speed to the utmost limit of practicability, so as to drive with slow direct connected motors and eliminate the use of gearing. The pump of the future, however, appears to be the centrifugal type. Whilst the efficiency is not so high as that of the plunger pump, other advantages, such as less cost for the same capacity, less space occupied, less attention, lubrication and repair, and more particularly its suitability for driving by electricity, as both pump and motor give the best results when working at a high speed, more than counterbalance the lower efficiency. Centrifugal pumps are already extensively used for high as well as low lifts, and give excellent results when used for sinking purposes.

As an instance showing the small attention required for electrically-driven ventilators, the author says: "The Reatean fan . . at an isolated ventilating shaft belonging to the Saar-Mosel Colliery Company displaces 110,000 cubic feet of air per minute, and is driven by a three-phase motor of 5,000 volts, keyed direct on the fan shaft, running at 300 r.p.m. The door of the ventilator house is kept locked; every three weeks the motor is cleaned, which takes two hours, and every three months fresh oil is put into the bearing cups, otherwise no one goes near the house. The fan has been running satisfactorily and continuously for a year under these conditions. Comment is needless.

As to winding engines, the author says: "Winding engines of high power have only lately been erected at one or two collieries, but a number of smaller engines, chiefly constructed on the Ilgner principle, are working at subsidiary shafts, where they are mainly used for lowering men and material." As is now well known, the two large winding plants erected in Germany are at the Preussen II Colliery, Westphalia, and the Zollern II Colliery, Westphalia.

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*From the "Electrical Review," London.

At the former, the winding engine is placed in a house close to the generator and winds with a Kœpe pulley; it is driven by a three-phase slip-ring motor keyed direct on the shaft. The generating plant for supplying power to drive the winding engine consists of two cross-compound horizontal steam engines, each driving a three-phase alternator of 2,000 volts at 86 to 94 r.p.m. The winding engine appears to be under good control and winds satisfactorily, but the effect of this system on the generator engines is not ideal. Between winds the generating steam engines are running at 94 r.p.m., with only sufficient steam to overcome the friction of the working parts at that speed; on starting to wind, their full power and something more is required of them, and they take their full steam and lose 7 or 8 r.p.m. in speed almost instantaneously, gradually regaining their full speed as the wind proceeds and the demand for power lessens. Near the completion of a wind full power is usually required in the opposite direction for braking purposes, and the same thing takes place although the engines are fitted with sensitive governors. Under such conditions this type of electric-winding engine is not likely to prove successful; but, on the other hand, if the generating station were very large and supplied power for a large number of other purposes, the effect of starting the wind would be barely noticeable on the steam engine driving the generators. It is unlikely that—except for very small winding engines—three-phase current will be applied to motors directly driving the winding drums, and where three-phase current can only be supplied this will be converted into continuous current by means of a converter fitted with a heavy fly-wheel.

At Zollern II Colliery the winding engine is constructed on the now well-known Ilgner system. An elaborate electric plant has been erected, the interesting characteristic of which—compared to others recently erected—is the exclusive use of continuous current and the shunt regulation of the motors. The winding engine is at present winding 1,200 tons of coal in 12 hours from a depth of 918 feet. This type of winding engine, although more costly than the type in use at the Preussen II Colliery, has a great advantage in demanding an almost constant instead of an intermittent load from the generators, at the same time being under very efficient control.

The question of electric or steam winding resolves itself into one of £, s. d. If the saving in fuel will more than cover the interest on the extra capital to install the plant, more depreciation and upkeep required with more delicate machinery, then by all means install electric winding plants; but, on the other hand, if the saving will not be large, as when the fuel is of little or no value, then keep to the steam engine, but install a good one. As Mr. Brown says: "Until electric winding engines of a large size have been conclusively proved to be as reliable and efficient as steam engines, and at the same time show a substantial saving in fuel and upkeep, sufficient to repay the original capital outlay, electrical power is not likely to be applied . . . where the winding engines consume the largest proportion of power required for working the colliery." Further, compared to collieries in this country, both the Preussen and the Zollern collieries are small as regards the output. An English engineer would expect at least double the output in the same time for probably only a small portion of the outlay invested at the Zollern Colliery.

WRINKLES.*

EDITED BY H. C. ABELL.

Stopping Air Leaks in Boiler Settings and Doors.

Packing cracks in brickwork and around door frames with asbestos wicking will materially reduce the amount of cold air going through, and will, if economizers are in use, help to raise the temperature of the feed water.

H. C. Hall, Fall River, Mass.

Receiver Steam to Heat Boiler Feed Water.

In case the exhaust steam does not heat the feed water sufficiently, we have found a gain can be made by admitting steam from the receiver of compound-condensing engine direct to heater.

B. E. Buttles, Denver, Col.

Increasing the Heat of Feed Water.

In the vertical header type of horizontal water-tube boilers the iron doors on the rear end of the setting radiate a great quantity of heat; by taking a lot of old pipe coverings of magnesia, etc., that was not fit for re-use on the pipes, breaking it up and mixing it with water, then baking it in short pieces of I beams for moulds we made a number of slabs, which were fastened to the inside of the doors; this saved a lot of heat, and as economizers are used the increase in the temperature of the feed water was noticeable.

H. C. Hall, Fall River, Mass.

Hot Feed Water.

Our electric equipment consists of six Corliss condensing engines and one De-Laval turbine. The condensing water is of such a quality as to be unsuitable for feed water, even though a suitable separator were used to take out the oil. We are contemplating installing a jet condenser on one turbine and using our regular boiler-feed water in it for condenser water. As there is no oil introduced into the water it can be used for boiler feed, heating it up to a certain degree before passing it through the regular feed-water heaters. With this arrangement the condenser may be made to fulfill two uses—that of a condenser and of a feed-water heater.

C. W. Humphrey, Denver, Col.

Turbine Boiler-Tube Cleaners.

As usually made, the cutters are so far in advance of the turbine that removing scale from the extreme end of the tube is difficult, as the cutters begin to cut about a foot from the end; making an extension piece to fit the tubes, so as to practically lengthen the tube a foot or more, solved the problem of how to make the cutters work on the extreme end of the tube.

H. C. Hall, Fall River, Mass.

Equalizing Heat in Steam-Heating Risers.

In a steam-heating system it was found that some risers were getting more steam than others, on account of being piped with Tees instead of Ys; a plug with a small hole drilled through it, inserted in the riser getting the most steam, will choke part of it off and send more through the other pipes, and so equalize better.

H. C. Hall, Fall River, Mass.

Grinding in Seats of Safety Valves.

It is sometimes necessary to grind in the seats of safety valves without disturbing the set of the spring; after taking off the lock, cap and test lever there are usually found two nuts for the fork of the test lever to lift valve from seat; when testing valve with boiler under steam, by inserting a piece of pipe between head bolt and these two nuts, and clamping the pipe tight, we can then take off the bonnet without disturbing the set of spring and grind in the valve.

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*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

H. C. Hall, Fall River, Mass.

NOTES ON THE INDUCTION MOTOR AS A GENERATOR.*

BY T. P. E. BUTT.

It has been known almost from the initial invention of the asynchronous alternating motor, generally known as induction motor, that, if connected to its supply mains and driven at a slightly higher speed than synchronism, it reverses its usual function and becomes a generator. There is another point in such machines equally interesting, and perhaps more useful, demonstrated by Danielson about two years ago. He described a method of converting an alternating current motor from asynchronous to synchronous by suitably exciting the rotor with continuous current. This is a point for which much use should be found, for such machines, in addition to possessing the inherent qualities of the synchronous motor, are self-starting. In order to effect this the motor is started up as an induction motor on light load, so that its speed approximates synchronism. At the right moment the motor is switched over from the resistance to a suitable source of continuous current, which pulls it into synchronism and maintains it at this speed. Such machines should be of use on inductive systems to raise the power factor, where such an inflexible arrangement as the ordinary synchronous motor may not find favor. Circumstances having placed the writer in a position to test the above principle, he assumed that the converse would hold good; that is, if power were applied to the rotor shaft, and its windings supplied with continuous current, the outcome would be a successful generator. The results are given in this paper, and, although not obtained under favorable conditions, are of interest.

About two years ago, when it was decided to augment the lighting supply of Johannesburg from the electrical plant of the Robinson Deep G. M. Company, it was found necessary to obtain an additional generator to provide a reserve for the existing plant, in case of accidents and to allow for general repairs. The management did not at first agree with this idea and the project temporarily fell through. It happened, however, that a 300 hp. 2,000-volt induction motor, originally intended for operating a hoist, had been lying dismantled on the property for several years, and the suggestion of the writer to convert this into a generator was entertained and adopted.

It should be explained here that the generator plant consisted of two direct-coupled three-phase 250-kw. machines working at 2,100 volts 60 cycles, and the power demand was such as to require one generator constantly running, the second assisting on the peak of the load for several hours during the day, whilst from 4:30 P.M. till midnight this second generator was loaded and often overloaded for the municipal supply, and although in case of accident to either generator the mine requirements would have had first consideration, the town supply was sufficiently remunerative to warrant the installation of another machine. Owing to the difficulty in getting an engine suitable for driving this machine at short notice it was arranged to operate it from one of the mill engines, a 500 hp. single-crank, compound engine, having at that time a surplus of about 300 hp. A friction clutch and pulley were attached to an extension of the line shafting, and rope drive provided. This necessitated the location of the generator in a wing at the extreme end of the power house, in a position invisible from the main switchboard.

To use the generator asynchronously involved very little alteration in the existing apparatus. The windings, of course, remained the same, but it was necessary to make provision for a variable speed for this machine, which, unlike the ordinary generator, requires a slight increase of speed to take an increased load. To get a variable speed from the mill engine was out of the question, and recourse had to be made to other means, viz., magnetic slip; this demanded the installation of the huge rheostat which originally formed the controller. This method would not be an efficient one if constantly used, but this was not intended, its use being restricted, as a rule, to the short period of time required in putting in, or taking out of parallel with another generator, to regulate the transfer of load. This arrangement demanded a permanent increase of speed above that of synchronism, and an increase of 5 per cent. was allowed, which was as much as possible, taking independent working into account. The controller was located near the generator and operated by motor from the switchboard, the position of its axle being indicated by luminous signals.

The arrangements for asynchronous running were practically complete, but for independent working an exciter was required, suited to the rotor winding, and for this purpose a disused plating dynamo was found having a capacity of 900 amperes at 30 volts. A low tension panel was installed near the generator, and the rotor windings connected to it, provision being made for rapidly connecting them to either the exciter or controlling rheostat.

The frequency of the asynchronous generator is determined solely by the currents supplied to it by the synchronous machine regardless of its own speed. The speed, however, must not rise above a certain critical value, or the power required from the prime mover will fall off rapidly, due to magnetic leakage, as in the case of the motor. Provision then must be made for this in governing the engine, or should this point be exceeded the engine might run away. The power-factor will be dependent on the amount of load supplied to the system, but independent of the nature of such load, so that any currents demanded by apparatus employed on the system not in phase with the working current must be supplied by the synchronous machine. Paralleling is of course, a simple matter, there being no need for synchonizing; it is always better though to get the speeds as near as possible to avoid disturbance to the system if the machine is of large relative capacity.

When the machine is connected up to operate as a synchronous generator, the rotor is simply transformed into a field magnet with a continuous iron surface, instead of the usual definite polar projections.

The first trial took place under asynchronous conditions; the machine, it should be stated, had a distributed winding, three slots per phase per pole in stator and four in rotor, the number of poles being 24, so that the permanent speed was 315 revolutions, or 5 per cent. above synchronism at 60 cycles. At this speed, or near it, and with the rotor resistance all in circuit, the switch was closed on the bus bars, thus parelleling it with a synchronous generator which at the time was delivering 90 kw. A current equivalent to 30 per cent. of the non-inductive full-load current was taken, and under these conditions the disk movement of a sensitive watt-hour meter in circuit was scarcely perceptible; the resistance was then cut out, until the whole load was taken, and steam was then shut off the synchronous machine, which continued running as a motor. After this steam was again admitted and the load increased and distributed by means of the rheostat on the two machines until a combined load of 362 kw. was carried, out of which the induction machine supplied 170 kw. This was the limit attained and was determined by the speed of the mill engine, which was not well governed and this point became unstable, thus causing sudden transfers of load between the generators and big voltage variations. A higher limit would have been obtained with a more favorable load—that is, motors of relatively small capacity or lights—but nothing less than 50 hp. motors were available, and the switching on of such at this stage would cause a marked fall in speed of the mill engine, upon which heavy surgings of current would take place, knocking the voltage beyond control and dislocating the service.

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*Abstract of a paper read before the South African Association of Engineers. From the "Electrician," London.

The machine was next tried as an independent generator. More interest was attached to this test, as if the operation proved successful, this method of working would have considerable commercial value. Two methods of exciting the rotor were available, either by cutting out one branch of the winding altogether, and connecting the other two in series to form the path for the current, or by connecting two branches in parallel and putting the combination in series with the third. This latter method was found to be more economical in exciting current. The trials under these conditions and with an induction-motor load resulted in attaining an output of 180 kw. before the engine governing gave trouble The excitation at this load was 7 kw. On a lighting load the results were extremely satisfactory, the output limit being largely increased; in fact, on certain occasions of big demand at the municipal lighting station, loads up to 315 kw. have been delivered with an excitation of 330 amperes at 25.5 volts. The engine under this load had got beyond governor control and fallen 4 per cent. in speed, but beyond this showed now signs of distress. This load, however, was abnormal, the maximum seldom exceeding 260 kw. The excitation required at no load was 138 amperes at 9.5 volts or 1,311 watts as against 27 amperes at 133 volts (3,591 watts) for the regular generator. At loads of 180 kw. on similar power factors of approximately 0.75, the excitations were 6.4 and 5.2 kw. respectively; here the longer air-gap of the regular generator tells to advantage. On similar loads (lighting) of 220 kw. the order is reversed, the regular generator requiring 5.2 kw. against 4.5 kw. of the converted machine.

The excellent results obtainable on non-inductive loads, neglecting the part due to less armature reaction, were attributable to the gradual assumption of the load, under lighting conditions, as distinguished from the sudden changes caused by switching on motors of large relative capacity, when on inductive loads. The temporary pulling up of the prime mover under the latter conditions, was, of course, noticeable on lighting loads when heavy banks of lamps were thrown on; but this occurred very seldom; and it is obvious that, although inconvenient in such cases, it had not the dangerous factor which such occurrences might mean to motor loads. This machine offers another field of usefulness as a motor, and with its present connections can be used in case of emergency to drive half the mill (100 stamps), no change at all being necessary beyond disconnecting the mill engine.

Independent working was certainly a success, and up to the time of the writer leaving the company it was nearly always used as such. The short air-gap and low flux density in the rotor, although favorable as a motor, allowed a big armature reaction when generating on inductive loads, but the effects of this would not have been so noticeable with automatic voltage regulation, such as, say, the Tirrell system. As to the use of such machines in mining districts, such as the Witwatersrand, it depends entirely on circumstances. No doubt in the near future isolated electric generating plants will disappear and be replaced by central supply stations, operating over suitable areas. When such a system is actually in sight, any immediate addition to the generating plants of mines likely to be affected by the change could be provided for by a machine such as described, which, on conversion of the systems, could at once resume its original role as a motor.

ENGLISH ELECTRICAL NOTES.

(From our London Correspondent.)

London Electrical Exhibition.

Shortly after these lines appear in print the electrical exhibition, for which extensive preparations have been in progress for months past, will be opened at Olympia. It is being opened on September 25 and will remain open for one month. There has not been a large and representative electrical exhibition in London, or indeed in England, since the Crystal Palace show of 1892. Between that date and this—13 years—has happened the great rise and progress of practically all heavy electrical engineering application, at any rate in England, so that the Olympian show has a splendid opportunity. The initiative in regard to the exhibition was taken by the National Association of Electrical Manufacturers, but they have also enlisted the support of engineers running electric light and power stations, and manufacturers in general.

We might say that the show has been primarily started with the idea of popularizing electricity and its varied uses with the general public, while it was also to be a counter-blast to the big Gas Exhibition which was held some months ago in London, and seemed to give a new lease of life to gas engineers and gas lighting, the values of gas companies' shares appreciating in the market as a result.

The exhibition comes at the right time for the City of London Corporation is turning out its electric arc lamps in some important streets and reverting to gas. The revival of interest in electric lighting is certain to follow the Olympian show.

The Electrified District Railway.

On Sunday, August 27, the Metropolitan District Railway Company commenced to run a new service of electric trains from Wimbledon and Putney, through London to Whitechapel. The company is now working the whole of its services by electric traction, with the exception of the Inner Circle service, the steam trains of the London & North Western Railway Company which traverse part of its track. The latter trains will be hauled by electric locomotives over the District Section later on, and the District Company is experimenting with a London & North Western train now, preliminary to that arrangement being carried into effect.

The Thornhill Power Station.

Another of the big power supply companies has finished the first of its generating and distributing sections. The Yorkshire Electric Power Company has one of the finest areas in the United Kingdom, containing a large number of towns which are expected to take supplies of electrical energy under a "bulk" arrangement, innumerable textile factories, collieries, engineering works, canals, etc. The area measures about 1,800 square miles in South and West Yorkshire, and in this area, according to the company's engineers' estimates, there is somewhere about 3,000,000 hp. at present, obtained chiefly from small steam units.

When the undertaking of the power company is complete it will have four generating stations, located at Thornhill, Bingley, Methley and Wath. Only the first of these has yet been proceeded with, and this will be extended, on the complete unit system, until its capacity is about 60,000 hp.

The present equipment of Thornhill

consists of four Babcock & Wilcox boilers and two Curtis steam turbines driving British Thomson-Houston alternators of 2,000 kw. each, running at 1,000 revolutions per minute. Current is generated at 10,000 volts, 50 periods, three-phase, and is transformed down at sub-stations to 2,000 and 400 volts. A third 2,000 kw. turbine set of exactly similar make is now constructing. Mr. H. F. Parshall is the designer of the installation. For some time past the company has been doing a good deal of educational work among the power users in its area, and it has just been holding an interesting exhibition of machine tools, showing some of the applications of motors to such purposes, for their edification.

New Officers of the Allis-Chalmers Company.

At the annual meeting of the stockholders of the Allis-Chalmers Company, held in Jersey City on Thursday, Edward D. Adams of New York, Mark T. Cox of East Orange, N. J., Edward C. Converse of New York, Joseph S. Neave of Cincinnati, O., and Edwin Reynolds of Milwaukee, Wis., were elected directors. At a subsequent meeting of the board of directors Walter H. Whiteside of Milwaukee was elected president to succeed Benjamin H. Warren of New York, and Henry Woodland of Milwaukee, Wis., was elected treasurer to succeed William J. Chalmers of Chicago.

Ohio Society of Engineers.

Mr. E. J. Miller, secretary of the Ohio Society of Mechanical, Electrical and Steam Engineers, requests us to announce that the annual meeting of the society will be held at Canton November 17 and 18, when new officers will be elected and some proposed changes in the constitution acted upon.

Elevated Road Accident.

A serious accident occurred last Monday morning on the elevated road in this city. A train on the Ninth Avenue line on its way down town jumped the track at 53d street. One car fell to the street, and another was overturned and took fire from the third rail. Twelve persons were killed and forty or more seriously injured.

Proposals Invited.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until September 26 for furnishing Eastern navy yards with the following electrical material: Schedule 125, cable and electrical supplies; schedule 126, mica, incandescent lamps, voltmeters, electrical supplies, etc. Blank proposals can be obtained of the Bureau in Washington or at the Navy Pay Office in New York.

On the same day the Bureau will also open bids for the delivery and installation of three water tube boilers and machinery for the power house at the Naval Hospital, Washington. Applications for proposals should refer to schedule 131, which will be furnished by the Bureau.

Sealed proposals, in triplicate, are being invited until October 4 for extending the electric lighting system at Fort Leavenworth, Kan. Full information and blank forms of proposal will be furnished on application to Captain J. E. Normoyle, Quartermaster, Fort Leavenworth, Kan.

Wire Rope Lubrication.

Elevator and other cables used for hoisting purposes are subject to both internal and external wear; the former is caused by the rubbing of the wires and strands upon one another under pressure in bending over the sheaves, the latter by rubbing and wedging in the grooves of the pulleys.

Unless the cables are kept well lubricated they wear and deteriorate rapidly.

As a lubricant for wire rope Dixon's Ticonderoga Flake Graphite has the indorsement of the leading manufacturers as well as the approval of those experienced in its use, because of the well recognized fact that flake graphite prevents the abrasion and wear of all parts coated with it. For this purpose graphite must be combined with suitable greases to make it adhere, but there has always been considerable danger and difficulty in applying grease to moving cables.

Dixon's Handy Graphite Rope Dressing supplies the ideal qualities of Dixon's Flake Graphite as a wire rope lubricant in such a form as to make it thoroughly acceptable to practical men who have used it. The package is of about the size and shape of an ordinary book and contains nearly three pounds of graphite lubricant. It is easily applied by holding the open edge of the package against the cable while in motion.

There is no trouble and no danger to the workman, no waste nor dripping off of lubricant. The economy and efficiency of Dixon's Handy Graphite Rope Dressing in prolonging the life of wire rope and saving the expense of frequent renewals of worn cables, should commend it to the careful attention of every firm operating hoists or elevators.

For prices and full particulars address the makers, the Joseph Dixon Crucible Company, Jersey City, N. J.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPT. 5. 1905

Electric Railways and Appliances

798,593. Fender. William J. Birchell, Phoenix, Ariz., Filed March 6, 1905.

798,673. Trolley. Robert G. Griswold and Charles C. Willits, Quincy, Mass., assignors of one half to Jerry Morrow, Wellston, O. Filed Oct. 13, 1903.

798,691. Trolley-Finder. Jerry Morrow, Wellston, O., assignor of one-half to R. G. Griswold and C. C. Willits, Quincy, Mass. Filed July 6, 1904.

798,742. Automatic Train-Signal. Clay H. Martin, Jackson, Mich. Filed Dec. 20, 1904.

798,911. Car-Fender. Paul Luther, Allegheny, Pa., assignor of one-half to John F. Fox, Greensburg, Pa. Filed May 12, 1905.

798,915. Electric Switch. McGonigale Miller, Louisville, Ky., assignor of one-half to Herman C. Tafel and one-half to Edward W. Wolff, Louisville, Ky. Filed Sept. 30, 1904.

798,968. Life-Guard to be Applied to Electric Tram-cars. Harry Lambelle, Middlesbrough, Eng. Filed Aug. 25, 1904.

Electric Lights and Appliances

798,932. Electric-Lamp Socket. George B. Thomas, Bridgeport, Conn., assignor to the Bryant Electric Company, same place. Filed March 6, 1905.

798,954. Electric Incandescent Illuminating Apparatus. Gerald B. Francis, Woking, Eng. Filed Dec. 17, 1904.

Electrical Machinery and Apparatus

798,606. Machine for Insulating Electrical Conductors. Charles H. Hawkins, Long Island City, N. Y. Filed Nov. 28, 1904.

798,641. Machinery for Making Electromagnets. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company. Filed Oct. 1, 1903.

798,648. Current-Motor. August Wiebke, Miles City, Mont., assignor of one-half to Robert E. Gruwell, same place. Filed July 14 1904.

798,689. Reversible Power-Transmitter. Alexander H. Masters, Greensboro, N. C. Filed Dec. 10, 1904.

798,702. Spark-Ignition Device for Explosive-Engines. Thornton B. Rennell, Denver, Col. Filed Dec. 30, 1903.

798,770. Governor for Dynamos. Charles A. Eck, Newark, N. J. Filed Aug. 12, 1903.

798,826. Regulator. Alphonse F. Pieper, Rochester, N. Y. Filed Aug. 29 1903. Renewed March 3, 1905.

Telephones and Telephone Apparatus

798,659. Annunciator. Charles C. Cadden and James I. Gemmill, Cleveland, O., assignors to the Williams-Abbott Electric Company. Filed June 11, 1903.

798,720. Telephone-Repeater. David H. Wilson, Chicago, Ill., assignor to George W. Kretzinger, same place. Filed Feb. 14, 1903. Renewed Feb. 11, 1905.

798,838. Telephone Exchange System. Ernest H. Strauss, Chicago, Ill. Filed Aug. 29, 1903.

798,853. Memorandum Attachment for Telephones. Frank R. Welsh, Philadelphia, Pa. Filed June 8, 1905.

799,010. Telephone System. Oscar M. Leich, Chicago, Ill., assignor, by mesne assignments, of one-third to said Leich, one-third to J. G. Ihmsen, and one-third to Max W. Zabel, same place. Filed Feb. 9, 1900.

799,019. Telephone Switch. Michael Setter, Chicago, Ill., assignor to the American Electric Telephone Company, same place. Filed Sept. 13, 1902.

Miscellaneous.

798,602. Automatic Carrier for Electric Wires. Frank E. Detchon, Delta, Col. Filed Aug. 4, 1904.

798,671. Automatic Telegraph. Alfred C. Gilmore, Chicago, Ill., assignor to James H. Peirree, trustee, Chicago, Ill. Filed March 10, 1903.

798,676. Electric Sign. Carl Haller, Chicago, Ill., assignor to the Haller Machine Company. Filed Oct. 19, 1904.

798,747 Electric Heater. Frank O'Hanlon and Joseph F Kelly, Philadelphia, Pa., and Henry S. Vautier, Camden, N. J. Filed Sept. 6, 1904.

798,748. Conduit for Electrical Conductors. William C. Robinson, Allegheny, Pa. Filed Oct. 5, 1904.

798,790 Electrolytic Process. Carl Hering, Philadelphia, Pa. Filed July 13, 1901.

798,803. Pocket Electric Burglar-Alarm. Herman A. Kreh, New Orleans, La. Filed Dec. 30, 1904.

798,804. Heat-Insulator. Emil Kune, Chicago, Ill. Filed Dec. 17, 1904.

798,906. Storage Battery. Alfred E Knight, Somerville, Mass., assignor to James H. Churchill, trustee, Quincy, Mass. Filed Nov. 16, 1904.

799,016 017. Electric Bell or Like Device. Carl J. Schwarze, Adrian, Mich., assignor to the Schwarze Electric Company, same place. Filed May 31 and Sept. 19, 1904.

THE TELEPHONE WORLD.

Independents Growing in Indiana.

Statistics have lately been compiled showing the growth of Independent telephone companies during the fiscal year ending July 30. The data has been computed from the tax returns of the 305 companies operating in 84 counties in Indiana. The total investment of these concerns, capital and bonds, have increased during the past year $3,718,458.90, or 51 per cent. In 1904 the companies were operating 106,554 telephones and in 1905 there had been an increase of 26 per cent., or 27,320 telephones. The gross annual earnings in 1905 exceeded those of 1904 by $1,055,145.88, or 77 per cent. The gain in net earnings for the same period was $118,115.56, or 35 per cent.

A prominent manager of one of these companies stated that the Independent telephone companies in Indiana have made immense progress during the fiscal year just closed. The thousands of new telephones that have been added show that a great deal of new work has been done. The increase in earnings show that the plants have been operated at a large profit.

In no other State in the Union at the present time are the Independents more prosperous or growing at a greater rate, and the future is the brightest in the history of the movement.

The Bethel-Newry Telephone & Telegraph Company has been organized at Newry, Me., for the purpose of constructing and operating telephone and telegraph lines in the towns of Bethel and Newry, with $5,000 capital stock, of which $540 is paid in. The officers are T. H. Jewett, of Bethel, and W. N. Powers, of Newry.

The Rose Hill, N. C., Telephone Company will build, equip and operate lines through the counties of Duplin, Pender and Sampson, and through other sections of the State. The home office will be at Rose Hill. There has been subscribed so far $1,200. The company may increase its capital stock to $50,000. The incorporators are James C. Williams, Gabriel H. Robinson and Maury Ward, all of Rose Hill.

A. A. Burch, manager of the Citizens' Telephone Company of Battle Creek, Mich., states that the outlook for Independents in that State is very good. His company continues constructing new toll lines, and has recently finished one to Gull Lake, Yorkville and Augusta. The Battle Creek exchange of the Citizens' Company is receiving orders for telephones faster than it can fill them.

The Jefferson County Telephone Company of Fairfield, Ia., recently added at an expense of $2,000 a new up-to-date 200 capacity switchboard, and is adding new ringing and listening keys and tables, new circuit changers, clear out drops and flashlight transfers, thus insuring more rapid and efficient service to its patrons.

The Luther, Ind., Telephone Company, capitalized at $1,500, has been incorporated. Henry Wilson, president, and William O. Stall, secretary.

In order to extend its system the White Cloud, Kan., Telephone Company has increased its capital stock from $75,000 to $150,000.

Iowa Independents to Meet This Month.

Independents from Northeastern Iowa will meet at Waterloo, September 15 for a general discussion of conditions and for the transaction of such other business as may come before the meeting. The Corn Belt Telephone Company of Waterloo will extend a hearty welcome to the visiting telephone men and it is expected that the meeting will be the largest in the history of the association. Further development and bettering of toll lines will be one of the leading questions to be discussed before the association. This is a question which will afford a great deal of interest and is of vital importance.

There will be no set programme, but matters of general importance to Independent telephone men of Northeastern Iowa will be discussed. There will be a number of mutual and rural companies represented. S. S. Lichty is secretary.

A guarantee bond of $5,000 has been made by the East Tennessee Telephone Company for its conduit system, which will be the first system of the kind to be installed in Knoxville. The plans have been sent to the Nashville officials and as soon as they are approved the actual work of putting the cables of the company underground will be begun.

The Columbia Telephone Company has secured a franchise from the board of trustees of Kinderhook, N. Y., to enter that village with its telephone lines, and a permit to establish a line in Valatie will also be asked of the authorities.

The entire telephone service in South San Francisco, Cal., is being replaced upon a new basis, repairs being made, old poles being removed and new ones installed. The changes now being made will make the system as good as that in any other community in the State.

A company of Hanover and Milano, Tex., citizens have organized what is known as the H. R. F. Telephone Company, and have constructed a line from Milano to Hanover.

It is stated that the Government plans to purchase 1,300 sets of telephones for the new fiscal year. Five hundred will be field telephones and the rest are to be used for coast defense.

A report from Hanford, Cal., states that P. Kerr Higgins, of Los Angeles, has applied for a franchise for a telephone system in that city.

The new rural telephone system of Williamstown, N. J., now includes nearly 100 subscribers, the circuits extending to Sicklerville, Cross Keys, Turnerville, Janvier and Cecil.

The Adirondack Home Telephone Company is laying underground cables in the streets of Potsdam, N. Y.

The Cecil Farmers' Telephone Company is building a line to Calvert, Md.

The Citizens' Telephone Company has applied for a charter in New Haven, Conn.

W. C. Polk, of Toledo, O., representing the Central Telephone Construction Company, has begun the work of overhauling the plant of the Home Telephone Company at Mobile, Ala., which the Bell Company made an effort to purchase a short time ago and failed. The work is preliminary towards arranging for a long-distance service which the company proposes to establish, and which, it is said, will extend as far as Syracuse, N. Y.

The Holston Valley Telephone Company has been organized at Holston Valley, Tenn., with the following officers: David McConnell, president; J. D. Thomas, vice-president; Philip Painter, secretary and treasurer. The purpose of this company is to construct a telephone line connecting Holston Valley and the King's Mill section of Virginia with Bristol. This very large and prosperous territory has up to this time been without telephone conveniences.

A $100,000 telephone and telegraph company, to be known as the Chicago & St. Paul Telephone Company, has been formed by Judge A. G. Zimmerman and Attorneys Rufus B. Smith and Alfred T. Rogers. It will operate from Hudson to Milwaukee and other cities in Wisconsin between St. Paul and Stillwater, Minn., and to points in Illinois.

The Citizens' Mutual Telephone Company, with a capital of $50,000, has been organized by owners of the Independent telephone systems at Terre Haute, Dana, Sandford and Libertyville, Ind., also certain towns in Illinois. The organization aims to obtain franchises for a central office in Paris, Ill.

C. M. Weeks, A. B. Swain and others have incorporated the Gold Ridge Improvement Company with a capital of $11,500 for the purpose of owning and operating telephone and telegraph lines at Sebastopol, Cal.

In the first year of its operation, lately completed, the Eastern Illinois Independent Telephone Company of Kankakee, Ill., made a fine showing. It has 1,500 telephones in operation and is growing at the rate of 50 a month.

The Cuyahoga Telephone Company of Cleveland, O., has 18,000 subscribers. Its gross earnings for this year are $551,475.13 with a surplus of $105,542 23.

During the coming year the Lancaster, O., Telephone Company will greatly improve its exchange. It is estimated $60,000 will be expended in Lancaster and $10,000 on the improvement of the country service.

A deal has been completed whereby the Norman County, Minn., Telephone Company becomes owner of the entire system of telephones in the county.

The Liberty Telephone Company is extending its line through Montville, Me., and down through the Prescott neighborhood to the Appleton line.

The Independent Telephone Company of Council Bluffs, Ia., will install a manual system.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Almond, Wis.—The village board has been asked to grant a franchise for an electric light plant. It is expected that this request will be granted at the next session of the board.

Chillicothe, Mo.—This city will soon have a new electric light plant to be owned by local capitalists.

Crawfordsville, Ind.—The city council and the trustees of the electric light plant lately met in special session to discuss the matter of repairing the electric light plant and installing a set of new boilers.

Fort Worth, Tex.—In the vote on the Armstrong franchise for permission to construct an electric light, power, gas and heating plant in this city, the majority was in favor of granting the franchise to Judge Armstrong.

Greencastle, Pa.—Work will soon be commenced on the new Greencastle electric light plant.

Greenville, Ky.—A committee, consisting of W. A. McKliffee, J. W. Lamb, J. W. Koontz, C. W. Taylor and T. J. Slaton, has been appointed to consider the construction of an electric light plant and waterworks at a cost of $36,000.

Indianapolis, Ind.—Alfred Kalter, a well-known promoter of this city, has purchased the electric light plant at Denver and secured a franchise for a new company. Mr. Kalter is supposed to be the representative of prominent Eastern capitalists.

Jackson, Miss.—The Jackson Light & Power Company has increased its capital stock by $10,000 and will enlarge its plant, installing new machinery for increasing the capacity.

Mountain Home, Ida.—Some time ago a franchise was granted to Seymour J. Bell, of Sumpter, Ore., to install an electric light plant here, and he has been at work on the $35,000 plant that he purposed installing.

Paulsboro, N. J.—A canvass is being made for subscribers to the proposed electric light service to be established for this place, Clarksboro, Mickleton and Berkley.

Richmond, Va.—An application will be made to the State corporation commissioners for a charter for an electric light and power company, to be operated in connection with the prospective electric railway from this city to Ashland. The capital stock is $100,000. Henry Anderson is president.

Washington, D. C.—A decision has been reached by the commissioners to have one lighting and heating plant constructed to supply both the new municipal almshouse and the industrial home school at Blue Plains, D. C., with electricity, instead of having a separate plant for each institution.

STREET RAILWAYS.

Albany, Ga.—There is a determined effort being made among some of our most public spirited and wealthy citizens and property owners to establish an up-to-date electric line in this city.

Auburn, Cal.—At a public meeting of citizens held recently resolutions were passed guaranteeing to John Martin a free right of way for an electric road from Grass Valley to this city.

Canton, Ill.—The franchise secured by the Illinois Central Electric Company for an electric railway through this city, has been transferred to the Cleveland Trust Company.

Cincinnati, O.—If plans which have been discussed by officials of the Cincinnati, Lawrenceburg & Aurora Traction Company are carried out within the next year, this city will have a fast trolley road into Indianapolis.

Dillsburg, Pa.—It is stated that cars on the Dillsburg Railroad will be run by electricity.

Fairmount, Ill.—The citizens have raised $1,600 of the $2,500 required for the interurban electric line that is proposed to be built from Catlin to this city.

Freeport, Ill.—The Freeport-Dixon electric railway seems a certainty. Peter Smith, who is interested in the scheme, announces that the franchise granted by the Dixon council some time ago has been accepted.

Ft. Scott, Kan.—Col. C.D. Beeson, general solicitor of the proposed interurban electric railway line, which contemplates making this city an important point on the line between Kansas City and Southwestern Kansas, is conferring with individual members of the franchise committee, with the view of taking up the franchise ordinances recently presented and passing the same.

Iola, Kan.—Hugh A. Holmes, of New York City, announces that the contract has been given for the proposed new electric railroad line from Kansas City to this city.

Lisbon, O.—Another railroad enterprise, having for its object the construction of an electric line from this city to East Liverpool, is in the field, and initial steps are being taken.

Menominee, Mich.—Work on the preliminary survey for the proposed electric railway between this city and Escanaba is progressing rapidly.

Mt. Vernon, N. Y.—The common council has voted to grant a perpetual franchise to the New York, Westcheter & Boston Railway. The road is to be operated by electricity, and the franchise gives the company the right to cross over or under various streets in this city.

New Albany, Ind.—The Louisville, New Albany, French Lick & West Baden Springs Electric Railway Company has been incorporated by John J. Weathers and Henry Terstegge.

Pittsburg, Pa.—President Frank G. Patterson, of the Southern Traction Company, has announced that within a month a contract will be awarded for the construction of 18 miles of road.—Application will be made September 18 for a charter for the electric street railway company, which proposes to construct lines in East Pittsburg, Turtle Creek and North Braddock.

Sidney, N. Y.—The outlook for the building of a trolley line between Ilion and this city is said to be very encouraging.

South Bend, Ind.—A trackless railroad will soon be put in operation here. It is designed to carry passengers and freight over the country highways in this vicinity.

Washington, Pa.—An important link in the connection of Pittsburg and Wheeling by trolley was lately provided for when a company was organized here to build a line from this city to Claysville, eight miles. Back of the scheme are D. M. Clark, J. R. Kuntz, W. P. Chambers, J. Y. Scott, J. L. Thistle and E. A. Willetts.

Waynesburg, Pa.—The Washington, Waynesburg & Monongahela Railway Company has been organized by local capitalists to build a trolley line between Washington and this city. The lines will pass through the towns of Swart, Dunns Station, Deerlick and Sycamore, and the townships of Franklin, Washington and Morris in Greene, and Morris and Franklin in Washington County.

POWER PLANTS.

Franklin Falls, N. Y.—P. B. McCahey, of Little Falls, has commenced the construction of the electric power plant here.

Mexico City, Mex.—The Mexican Power Company, a Philadelphia concern with an authorized capital stock of $10,000,000 gold, operating under a New Jersey charter, has been organized. It will utilize the water power of three rivers in the State of Mexico near Toluca and will send electrical current into this city estimated at 90,000 hp.

Tishomingo, I. T—The Southwestern Land, Power & Development Company contemplates developing water power and building an electric plant for the transmission of said power by electrity to operate a cotton mill, woodworking plant, etc., which will be established.

BIDS WANTED.

Columbus, O.—Sealed proposals will be received by the board of public service of this city at the office in the City Hall Building until 12 o'clock noon of September 19, for the sale and removal from the property of the city electric light plant, which consists of engine boiler, condenser, lamps and other equipment necessary to make up a complete plant. Each bid shall contain the name of every person interested in the same, and shall be accompanied by a certified check on a solvent bank of this city in the sum of at least $100, said check to be made payable to Charles H. Frank, secretary of the board of public service, and to whom the bids are to be addressed.

Fayetteville, N. C.—Bids will be received until October 1 for improvements to the electric light plant. E. W. Trafford, Richmond, Va., designing engineer, and W. Thomas Jones, superintendent.

High Point, N. C.—The Dixie Milling Company of this city wants prices on one 40 hp. motor and 10,500 feet of wire to run same from power plant.

Mt. Holly Springs, Pa.—Bids for lighting this town by electricity are asked by the borough officials. George R. Klopp, secretary, will furnish specifications and particulars on application.

Warren, Pa.—Sealed proposals will be received till 12 o'clock on September 15, for completion of the electric lighting system at the State Hospital for the Insane. Address S. R. Mason, Warren, Pa.

Wisner, Neb.—Sealed proposals will be received by William Armstrong, clerk of the board of village trustees, until 8 P.M. Septembr 18, for the furnishing and installing of an electric lighting plant.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 16@16½c.; Lake 16@16½c.; casting, 15¾@16¼c.

The Philadelphia Traction Company has declared a semi-annual dividend of $2, payable October 2.

J. G. White & Co. recently took over the management of the Helena (Mont.) Light & Traction Company.

Books of the Philadelphia Electric gold trust certificates will close September 15 and reopen October 2.

A rumor comes from Milwaukee that E. C. Converse, of New York, will become president of the Allis-Chalmers Company in the near future.

The wreck on the Manhattan Elevated has had, so far, but little effect on Interborough stock. It sold at 215½ on Monday against 215@218 quoted at Saturday's close.

A dividend of 2½ per cent. has been declared on the preferred stock of the Union Traction Company of Indianapolis, Ind., payable October 2 to stock registered September 25.

The Twin City Rapid Transit Company (Minneapolis) has declared the regular quarterly dividend of 1¾ per cent. on its preferred stock, payable October 2 to stock registered September 16.

In answer to reports recently circulated that the railway lines and lighting systems of Manila were about to be sold it is stated by a representative that J. G. White & Co. still control the system and had no intention of selling it.

G. Martin Brill, head of the new combination of street car builders, has caused a change in the financial plan of that company regarding the $2,000,000 working capital. The first plan was to hold $2,000,000 of 5 per cent. bonds, but now it has been decided to sell them at once.

The August earnings of the United Railways Company of St. Louis, Mo., will show a heavy increase over 1904 and will far exceed the July gross receipts of $725,000. An officer of the company estimates that the returns for the past month should be in the neighborhood of $750,000.

A syndicate of California and Eastern interests has signed a preliminary agreement for the purchase of the stocks of the San Francisco Gas & Electric Company and the California Gas & Electric Corporation. A new corporation is to be organized to take over the stock of the two companies.

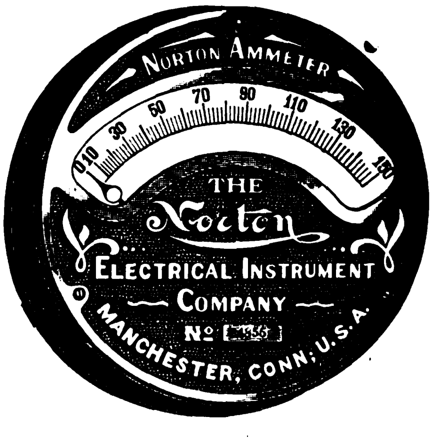
The Brooklyn Rapid Transit Company made public its report on Saturday for the year ended June 30 last, showing the largest gross earnings in the history of the company. The amount so earned was $16,333,444, which compares with $14,738,700 last year and $13,280,321 in 1903. The departments which showed the greatest increase in gross receipts were freight, mail and express, which gained 72.59 per cent. over last year.

The final report of the Citizens' Savings & Trust Company of Cleveland, O., as receiver of the Lake Shore Electric Railroad Company, has been filed in the United States Circuit Court at Cleveland. The receiver asks that he be discharged and the receivership discontinued. The report shows that $968,262 has been disbursed by the receiver in accordance with the order of the court. The receiver turns over to the company $800,000 over and above all claims. The Lake Shore Electric Railroad was one of the Everett-Moore Syndicate properties and was put into receivership at the time of the syndicate's financial embarrassment three years ago.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Sept. 11
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	215½
Manhattan Elevated Railway	164
Metropolitan Street Railway	127
Metropolitan Securities	80½
Ninth Avenue	197
Third Avenue	127¼
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	67⅛
Brooklyn City Railway	239
New Orleans Railway	36½
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81¾
Philadelphia Traction	101
Union Traction	61⅝
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	16
do. do. do. pref	60
West End Street, com	97½
do. do. do pref	113
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	8⅛
do. do. pref.	37
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	16⅞
do. pref.	59
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	19½
do. do. pref.	25½
Westinghouse, com	166
do. pref.	190
General Electric	180
Boston.	
Edison Electric Illuminating	253
General Electric	180
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	158
National Carbon, com	60¾
do. do. pref.	115½
Philadelphia.	
Electric Company of America	11¼
Electric Storage Battery, com	86¾
do. do. do. pref.	86¾
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	140
Western Telephone Company	16
New England Telephone Company	134
New York.	
American Telegraph & Cable Company	190½
Commercial Cable Company	210¼
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	94½
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Chicago Subway	82⅛
Otis Elevator Company	60
Standard Underground Cable	..
Twin City Rapid Transit	116½

NORTON VOLTMETER
10 30 50 70 90 110 130 150
THE
Norton
ELECTRICAL INSTRUMENT
COMPANY
No. 6958
MANCHESTER, CONN., U.S.A.


NORTON AMMETER
10 30 50 70 90 110 130 150
THE
Norton
ELECTRICAL INSTRUMENT
COMPANY
MANCHESTER, CONN., U.S.A.

NORTON SWITCHBOARD INSTRUMENTS.

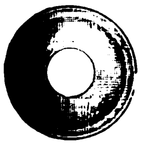
Style "C" in Ranges:

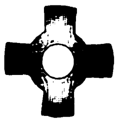
0 to 5 volts.
0 to 750 volts.
0 to 10 amperes.
0 to 1500 amperes.

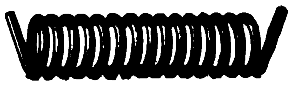
Dead Beat and made for either Back or Front Connections.

The Norton Electrical Instrument Company,

Main Office and Factory, Railroad Avenue, MANCHESTER, CONN.







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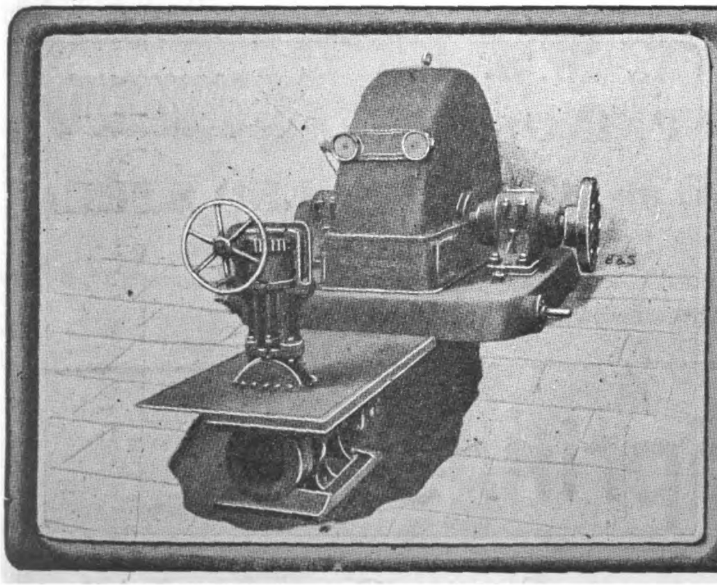

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EDITORIAL NOTES.

"Electricity's" New Educational Series.

A series of articles have been recently completed in the columns of ELECTRICITY, which touched upon every department of applied electricity, from the beginning to the end. This birds's-eye-view of the science and practice comprised more than a mere sketch of each individual field of work. In all cases the subject was thoroughly treated, and the results given in a simple and readily comprehensible manner. The supply of copies containing these articles were rapidly exhausted, and, although it was gratifying to ELECTRICITY, to find how great an interest has been taken in the ELECTRICITY Leaflets, it was embarrassing to find how low its stock of reserve copies had fallen in consequence. For this reason we are about to publish a new series of articles from the pen of Mr. Newton Harrison, which will cover the field of Light, Heat and Power. The letters of commendation, and the attention awakened by the last series, we expect, will be more than duplicated in this new instance.

In the last series, the enormous field to be covered gave little opportunity to other than outline the fundamental principles of application and development of electricity in the last century. The new series, however, will embrace the specific subjects of Light, Heat and Power exclusively. The articles composing it will be written in a simple, readable manner, and, without being unduly didactic, will touch upon the underlying principles, and such of the past and present practices, as will suffice to make the reader feel thoroughly in touch with the progress made in these departments of electrical engineering.

At the present writing, when text books are being turned out wholesale, it is hard to realize that of them all few reach that position of authority in the public mind which makes of them productions of value. The difficulty arises through the old-fashioned plan of treating subjects in the same humdrum manner. Of this the public are aware, and they therefore turn more and more to the columns of standard publications for the information they seek. This new series by Newton Harrison, E. E., will be readily recognized, as belonging to that class of easy reading articles, which while presenting technical and scientific facts, does so in a manner requiring no extensive preliminary training to comprehend.

ELECTRICITY offers this new opportunity to its readers in its next issue, believing that before the series is completed they will admit that if anything the high standard spoken of reached far above their expectations.

* * *

Electric Power Supply in South Africa.

The proposal that the great Victoria Falls on the Zambesi should be utilized, after the manner of the Niagara Falls, in connection with the development of the mining, railway and other works in South Africa and Rhodesia, has been brought up time and time again during say, the last 10 to 15 years, as the frequent references to the subject in ELECTRICITY have shown. In fact, ever since Prof. George Forbes went out at the command of the late Cecil Rhodes, to investigate the idea and report upon its practical possibilities, it has been alternately revived and dropped.

At the present moment, however, it has reached a more advanced stage than on any previous occasion when it has been under consideration, among other evidences in that direction being the visit of special commissioners to Niagara to collect data for the guidance of those who have obtained the Victoria Falls concessions from the chartered company. The meetings of the British Association for the Advancement of Science may also be said to have carried the scheme still one step more, nearer to actual realization. Although for the most part the Association's meeting has been one gigantic picnic it has enabled some of the leading electrical engineering minds to be brought to bear upon electric power development on the spot, and the discussion which took place with such an assembly of distinguished scientists and engineers in their midst, has probably done more to urge upon the attention of the Rand mining engineer and manager what are the benefits following the use of electric driving, than any little discussions that may take place from time to time at local gatherings of South African societies. Publicity—abundant publicity—we all know, has a large part to play in bringing about big reforms of any kind, and the publicity which has been accorded to all of the doings and discussions of the British Association while in South Africa has been unparalleled in generosity. All of this must needs tell, and as evolutionary processes do not permit any man "to bathe in the same river twice," so South Africa will not be the same after the English scientists and engineers have packed their trunks and returned home as it was before.

The question of electric power distribution on the Rand was the subject of two lectures or papers read at Johannesburg at the end of August by Prof. W. E. Ayrton, F R.S., and Mr. Robert Hammond, and both were discussed together. Prof. Ayrton referred to the commercial success achieved by electric power distribution in both Europe and America, and dealt with the question which is sometimes raised as to whether there is the same scope for an industrial revolution in South Africa. The answer at first sight, he said, would be "No!" Seeing that the map wss blackened with coalfields, some of which were reported to be producing coal nearly equal to the best Welsh, but on the other hand they had to consider the experience of South Wales and Tyneside where large use was now being made of electric power. The possibilities of electrical utilization at Victoria Falls were enormous, but he urged safeguarding the beauty of the Falls—a convenient position and location for a power station would be at the end of the second gorge. It would not be wise to start by constructing a transmission line from the Falls to Johannesburg, though it was quite workable, and he advocated electric transmission of power, but there was not yet sufficient demand for power along the line of route.

Mr. Robert Hammond whose lighting station offspring in the United Kingdom is like the promised seed of Abraham "like the sands of the sea shore" for number, in his paper, confirmed the remark of Professor Ayrton, that there are no engineering difficulties in the way of supplying electrical energy to all the mines on the Rand from a central power house utilizing the Falls, but in his opinion the cost thereby would far outweigh the annual outlay on coals. He unfolded before his hearers a more economical scheme for distributing power by burning coal nearer the Rand, by means of which power might be supplied at the rate of one and one-half cents per unit, which would make it far more economical than continuing to use steam power.

It seems that in this view Mr. Robert Hammond was not without supporters, though Mr. Alexander Siemens contended that by utilizing the Falls they would get the energy at any rate quite as cheaply.

It is to be hoped that this discussion will immediately extend the adoption of electric power in South Africa. Or if not, it cannot but be as "bread cast upon the waters"—returning later.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

An extensive American electric traction and lighting system is about to be constructed in the city of Para, Brazil, the commercial center of the Amazon Valley.

In connection with the annual convention of the American Street Railway Association, which is to be held in Philadelphia next week, will be an exhibition of the latest appliances in street railway traction, including cars, motors, dynamos, trucks, registers, air brakes and all kinds of electric machinery, which are in use in a complete railway system.

Japanese dock yards, factories and other works are calling for labor-saving machines very freely. So far American manufacturers of such have benefited largely, but there are a good many orders yet to be got. American electrical machinery is particularly popular.

The Great Northern Telegraph Company of Copenhagen has obtained a license for laying out and operating a submarine cable to Iceland. The cable is to be laid from the Shetland Islands, off the north coast of Scotland.

The wireless block system now being used on the Alton Railway is proving successful, and all locomotives are being equipped with it.

The Erie Railroad Company has arranged for the immediate expenditure of $225,000 for the installation of the Hall Electric Semaphore Normal Clear System, operated by stationary storage batteries.

The new high-speed electric line to Jamestown, N. Y., is being tested. The line is said to have cost nearly $1,000,000.

An economical method of using up arc lamp carbon ends is described by L. Bernard in the "Elektrotechnische Zeitschrift." It consists, says the "Electrical Engineer," London, in cementing several ends together so as to form a single long carbon. The cementing is carried out by cutting the ends of the pieces so as to allow them to fit together, covering these ends with a paste made of water glass and powdered carbon, and then lightly pressing the pieces together. Such made-up carbons were found to be satisfactory in every way. They burnt, both with direct and alternating currents just as well as new carbons, even at the junctures. Tests proved that the resistance was but little greater than that of new carbons, whilst as regards mechanical strength the made-up carbons, when subjected to a uniform stress, were found, if anything, more liable to break between joints than at the joints.

According to the "Electrician," London, the Allgemeine Elektricitats-Gesellschaft of Berlin, is putting on the market wires and conductors for electrical purposes with a new kind of insulation claimed to be superior electrically and mechanically to silk-insulated wires. The new insulating material is a special chemical compound which is distributed evenly and in many thin layers, on the wire by special machinery. It is stated that the covering is only about 0.02 mm. (0.0008 inch) thick, is non hygroscopic and is unaffected by temperatures up to 150 degs. C., being at the same time strong and elastic. A thickness of 0.02 mm., it is said, will withstand, on an average, 1,500 volts without breaking down.

CALIFORNIA ELECTRIC PLANT OF THE MONTEREY COUNTY GAS AND ELECTRIC COMPANY.

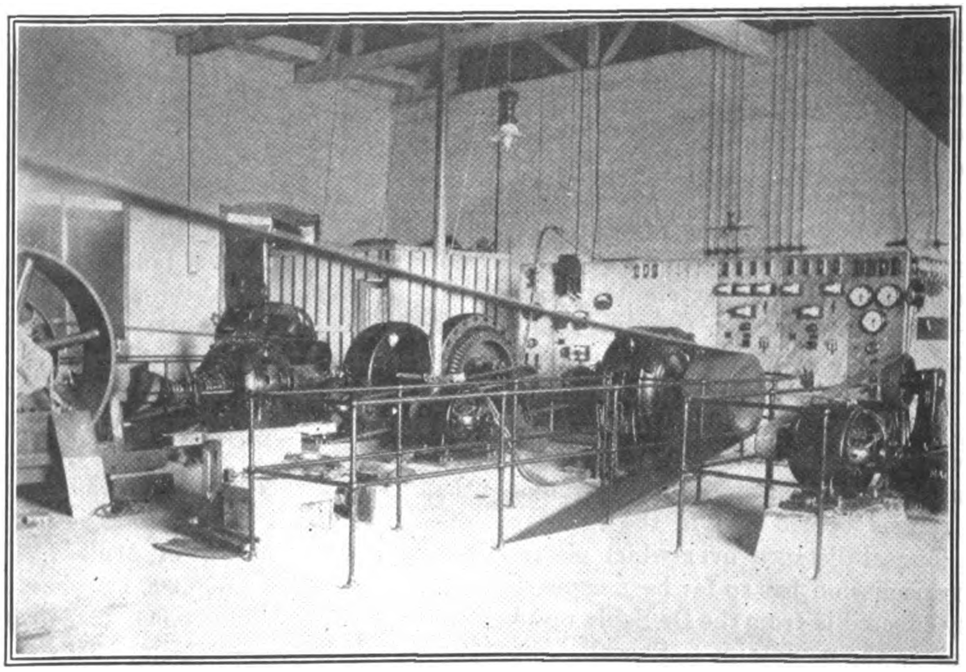
BY FRANK C. PERKINS.

In America as well as in Europe the various gas and electric companies are finding it to their advantage to consolidate, and in many places gas companies are installing electric light plants of their own, in some cases operated by gas engines and in others by steam engines. The Monterey County Gas & Electric Company of Monterey, Cal., is a successor to the Salinas Water, Light & Power Company, the Salinas City Light & Water Company, and the Monterey Electric Light & Development Company. Waterworks Companies are now often consolidated with the light and gas companies, the pumps being operated by electric power or by gas engines, power distribution by electric current, and lighting by gas and electric distribution. The waterworks and steam electric plant at Salinas include pumps driven by gas engines of the White and Middleton type, and National and General Electric alternators of the single phase type, operating at a pressure of 1,040 volts, driven by a Columbian Corliss engine of 16-inch stroke with cylinder 42 inches in diameter, the same engine being so arranged as to operate the triplex pump in case of necessity caused by a breakdown. In the same building is a modern gas plant supplying water gas made from crude oil.

The gas electric and street railway plants supplying service to Monterey, New Monterey and Pacific Grove, are owned by the Monterey Gas & Electric Company. The steam electric plant at Monterey is installed in a corrugated iron building 52 feet wide and 143 feet long, the engine room of which is shown in the accompanying illustration, the gas works being located in the rear and having a length of 66 feet.

The boiler plant includes three Murray return tubular boilers of 150 hp. each operating at a pressure of 150 lbs. per square inch. These boilers are supplied with a fuel of crude oil which is pumped from a tank 24 feet wide and 7 feet deep, the oil being pumped directly into this tank from the oil tank cars placed on the siding opposite the power house. In order to easily pump the oil from the car tanks steam is passed into heating coils off the tank car and the vicosity of the oil being reduced, two Stillwell-Bierce pumps force the oil to the storage tank through a Worthington meter, one pump being held in reserve. The oil used has a gravity of about 15 degrees Beaume, and costs about 76 cents per barrel of 42 gallons.

There are four engines of from 150 to 250 hp. capacity of the Buckeye, Weatherill-Corliss, Nagle-Corliss, and Lane and Bodley-Corliss types operating at 175, 94, 108 and 98 r.p.m. respectively. These engines are connected by belt transmission to General Electric and National two-phase alternators and direct current machines of from 150 to 200 kilowatts capacity each. The alternators supply a two-phase current of 2,300 volts pressure and the direct current machines supply a continuous current of 550 volts for railway service. A National motor generator set is also installed consisting of a 550 volt railway generator, of 150 kilowatts capacity, directly driven by a revolving field synchronous motor with a rating of 162 kilowatts, operating at a speed of 720 r.p.m. Between the motor and the generator is a 22 inch pulley with a 16 inch face belted to the 200 hp. high speed Buckeye engine flywheel. By this arrangement both the units of the motor generator may be operated as direct and alternating current dynamos, and affords a link by means of which the two-phase lead may be coupled with the railway load allowing a day alternating current service to be maintained in connection with the railway load with a maximum efficiency of operation.


Monterey's Gas and Electric Plant.

The Monterey Gas Works is equipped with apparatus installed by the California Light & Fuel Company and includes a scrubber and scrubber-condenser as well as superheater, washer and generator. At the Monterey gas works salt water is used for gas making, while at Salinas fresh water is employed. During one month of 1904 more than 500,000 cubic feet of gas was made, the average amount of oil used being a trifle over 210 gallons per day, the average gas made being 17,000 cubic feet per day, this being an average of about 12 gallons of oil per 1,000 cubic feet of gas made.

THE COMMERCIAL VALUE OF OUR WATERFALLS.

BY GEORGE ETHELBERT WALSH.

Engineering developments in the past decade have given a new value to waterfalls and mountain streams, which is rapidly shifting the industrial centers of the country, and changing topographical conditions in a remarkable way. When Niagara was first harnessed the transmission of electrical energy any great distance for commercial purposes was considered of doubtful expediency, and as a direct result of its exploitation groups of new industries sprang up around Niagara to utilize the electrical current for manufacturing and experimental purposes. But since then the practical transmission of current over long distances has progressed so rapidly that industrial sites are no longer limited to restricted areas dependent upon the proximity of powerful waterfalls or streams. Instead of the manufacturing towns and cities of the coast going to the mountain streams and waterfalls, the latter are sending their energy over scores of miles of copper wire to the mills and factories of our seaports.

The value of a waterfall or stream for electrical purposes depends fully as much upon the market for the current as upon its power to generate current at little cost. There are scores and hundreds of streams in this country with high water heads which have not been developed for electrical purposes because of their inaccessible location. In the Rocky Mountain sections there are many streams from 1 to 10,000 feet above the sea level. With such tremendous heads the waters of even a small stream could be made to turn giant turbines and furnish electrical power sufficient to operate the cars and factories of whole towns and cities. When it is remembered that the fall of one cubic foot of water per second through a height of 100 feet develops 11.2 hp., a slight conception of the value of a mountain stream with a 10,000 feet head can be realized. Even though such a stream was little more than a brook, the water conducted down a flume to the valley 10,000 feet below would be powerful enough to turn the largest set of turbines ever built.

Owing to the scarcity of coal as fuel on the Pacific coast, electrical engineers sought to draw energy from water power high up in the mountains, and they have developed long-distance transmission of electricity to a point where geographical conditions have suddenly lost much of their meaning. The Pacific coast cities are drawing their power, heat and light from the Sierra Nevada and other mountain ranges located back in the interior. The longest distance over which electrical transmission has so far been commercially effected is from the De Sabla power house in the mountains to Sausalito, opposite San Francisco, a total distance of 232 miles. Another line, 142 miles long, runs from Colgate power house on the Yuba River to San Francisco, carrying current for miscellaneous use. A third line, beginning at the generating power plant at Electra in the Sierra Nevada Mountains, delivers daily 10,000 hp. in San Francisco, 154 miles distant. Electrical power used in Los Angeles is drawn from a power house on the Santa Ana River and Mill Creek, over 83 miles back from the coast. At the Mill Creek power house the head of water is nearly 2,000 feet. Mill Creek is a small stream, and its supply of water would appear to the casual visitor of no commercial value, not even though it flowed close to the suburbs of a city. Yet by virtue of its altitude it is made to perform feats little less marvelous than those which we are accustomed to read about in the Arabian Night stories. A single cubic foot of water from this Mill Creek conducted down the long flume is capable of developing 117,800 foot pounds or 214 hp. per second. Added to this remarkable fact is the no less important one that it delivers the power to mills and factories situated 83 miles away. Here a single cubic foot of water, perched high upon a mountain range, 83 miles back from the coast, is made to do the work of powerful steam engines working continuously on the scene at a considerable expense in coal consumption.

The value of a waterfall to-day is measured not only by its volume, or by its location near large cities or manufacturing centers, but by its water-head. The small waterfalls situated at great heights may furnish more power than the sluggish river ten times as broad and deep. The cost of harnessing a small mountain stream is proportionally less than that of a Niagara, whose power is so great that it is difficult to separate a portion of it for commercial uses. The mountain streams of California are tapped by wooden flumes, which carry the water long distances down the sides of the mountains to the power house. So powerful is the flow of water at the generating house that the largest and heaviest turbines must be built to utilize it.

No one has yet been able to measure the actual or potential power of Niagara, but it is assumed by electrical engineers that some 4,000,000 hp. could be developed from it before the total energy of the cataract would all be utilized. The annual profits on 4,000,000 hp. should be anywhere from $20,000,000 to $40,000,000 at the lowest estimate. This would represent fair interest on something like a billion dollars. So for the sake of argument it may be assumed that Niagara, as a power-producer, is a property worth approximately a billion or more dollars. This value could, however, only be attained through the long-distance transmission of electric current for use in towns and cities hundreds of miles from the falls. The actual tangible value of the cataract is dependent upon the market for the current, and this can be obtained only by the widening of the circle of consumers by long-distance systems.

There are several smaller streams which have as high a water head as Niagara, and the water—cubic foot for cubic foot—is worth as much for power development as that which tumbles over the cataract made famous in history and science. The water at the great Spiers Falls on the Upper Hudson has a head of 80 feet, and it delivers over 30,000 hp. to Albany and other distant cities. In Montana the Canon Ferry power house on the Missouri receives its water from a fall 30 feet high, and the water-wheels develop power to supply the city of Butte 65 miles away with all the electrical energy it needs.

With these striking examples of the practical value of waterfalls and high streams before us, it is easy to assume that the country's wealth in water power is unfailing and far reaching in effect. There is no longer a fear of a fuel famine. With our waterfalls and streams all harnessed so that their full energy could be used, the light, heat and power generated therefrom would be sufficient to make us comfortable for the rest of our existence on this planet. Within a few years such mighty transmission of power, heat and light could be effected that the total exhaustion of our coal mines would have only a temporary crippling effect upon our industries. The readjustment is in a fair way of progress to-day. Scores and hundreds of large and small streams of water are being developed for generating electric power and mills and factories are drawing their supplies of energy from distant streams in all parts of the country.

In the Central, Southern and New England States, the water courses have an average altitude above the sea level sufficient to make them of great commercial value. A stream 500 feet above sea level is a mammoth power producer—potential, it is true, but nevertheless real and actual. Such streams flow through New England in many places only a dozen or two miles back from the coast cities. Others at an altitude of 1,000 to 1,500 feet above the sea level waste more power than is needed to run nearly all of New England's cotton, shoe and button mills. It was impracticable to transport the mills and factories to the inland waterfalls, but to-day the energy generated can be transmitted to the mills and factories on their old sites.

The harnessing of small streams in series is one of the important developments of modern methods of long-distance transmission of electric energy. A State or section abounding in numerous small streams with fair water head no longer may be considered outside the boundary of hydraulic development. Each small stream is considered as a single unit in a series of water power plants. Streams that have a fall of only a few feet per mile can be utilized at different points along their course for generating power that can be sent scores of miles away to turn the wheels of factories and mills. In New England where small streams are very numerous electrical transmission systems have been built up within the past few years by joining the power of many small units into one gigantic line that carries the energy long distances. The industries which have centralized in certain cities along the coast thus draw their power from the insignificant inland streams whose waters for ages have been wasted. Many of the old water-wheel mills that were abandoned years ago, because manufacturers moved away from them, are being revived now to form links in the electrical chain that connects the mountains with the seashore. The cotton mills of New England which built up their industry from coal and hydraulic power are changing to electricity.

In the summer time the streams which turned the water wheels of the cotton mills would dry up so that the mills either had to shut down or use auxiliary steam plants. This difference in the water flow in summer and winter is one of the problems which the modern electrical engineer has to consider carefully. The fall is so great some times that the water wheels are left high and dry above it. The Connecticut River, for instance, shows a mean discharge of 16,314 cubic feet per second in one month, and drops to 3,453 cubic feet in late mid-summer. Even more pronounced is the fall in dry weather of some of the smaller streams. A few of the New England streams show wide variation in the amount of water within the same month. The Androscoggin River in Maine has changed within 30 days from a maximum discharge of 18,486 cubic feet per second to 3,165 feet. The control of the waters of such streams is obtained only through the construction of reservoirs or dams, which will hold the waste water of winter and spring for summer and fall use. Small streams with a high head can be converted into powerful electrical units for a transmission line by damming them up so that the surplus water is not allowed to run to waste.

The New England cotton mills will soon draw nearly all their power from the distant inland streams where electricity can be generated the year around at little expense. The necessity of this is felt by competition with the Southern cotton mills, which have already entered largely into the use of hydro-electrical power. At Fayetteville, N. C., a dam 1,500 feet long has been built to back up the water for 12 miles to run the cotton mills located along the course. Numerous turbines are installed to receive the water for generating electricity to operate the looms and spindles of the factories. The water supply will thus be made constant the year round, and the summer "shut-down" for lack of water will no longer throw the mills out of use. In New England a similar example is found in the cotton mills on the Blackstone River where 1,500 hp. is delivered in the winter and 600 in summer, with an average the year round of 1,000 hp., but by the construction of a reservoir this amount can be augmented as needed to almost any amount of horse power. At Columbia, S. C., a dozen cotton mills have been drawing upon electrical energy generated by streams for their operation. They have entered upon a period of activity which takes no account of winter or summer, of dry or wet seasons. The electric power is sufficient for all needs every month in the year.

The question of the commercial limit of electrical transmission is now of paramount interest to the country, and particularly in those parts where great hydro-electric power seems unlimited. Long before the Pacific coast engineers carried their energy from the mountains to the coast, is was considered inexpedient and unprofitable to transmit electrical energy in bulk 50 or 100 miles. Length, cost of conductors and insulators are factors that enter into the problem. When 60,000 volts are sent over a line the cost of insulators becomes almost prohibitive. In order to send a current a hundred miles or more the consumption of energy is large, and there may be a point where further transmission would prove impossible or at least commercially unprofitable. In the long distance transmission systems of California several power houses are used, each drawing its energy from different water sources, or at differet points on the stream. Thus the longest transmission line from the Sierra Nevada has five power houses, and the Los Angeles system has three. It is by combining small units along the way into one great system that the best long-distance transmission service is obtained, and the country cut up by numerous little streams has really an advantage over another with only one or two great cataracts.

The limits of long-distance transmission cannot thus be arbitrarily fixed. The distribution of the energy may grow in time into one wide, complex system, drawing its energy from numerous sources, and supplying power as needed hundreds of miles away from the first beginning of the plant. This may be called the period of consolidation and centralization of water power and electrical energy.

The commercial limits of long-distance transmission of electrical energy must be determined by the cost of fuel in the districts through which the lines pass. We have some notable instances of where electrical energy is supplied to distant cities at less cost than it can be generated by coal on the spot. In spite of the low cost of coal in Buffalo, the Niagara Company can deliver and sell profitably some 20,000 kilowatts of electrical energy to the city, and in Montreal, with coal at $3 per ton, electricity is brought from the Shawinigan Falls to displace steam engines on a large scale. The city of St. Paul likewise uses large amounts of electricity transmitted over a line 25 miles long, although coal and other fuel is very reasonable in cost. On the California coast, the long-distance electrical transmission companies have to compete with a fuel even cheaper than coal on our Atlantic coast. California oil has supplanted coal almost completely for power development in mills, shops and railroads. With liquid fuel ranging from 65 cents to $1 per barrel, coal has no chance for general power development; but in spite of this electricity comes from the distant Sierra Nevada Mountains and openly competes with electrical power plants operated by liquid fuel.

Albany, Troy and Schenectady are on the line of the Erie Canal and great trunk railroads; but the fuel problem with them has not interfered with the building up of a great group or combination of electrical transmission systems which draw their power from waterfalls 30 to 40 miles away. The long-distance electrical transmission has no arbitrary limits, and its future developments must depend upon conditions governing the cost of delivery to different points and the price of fuel. Unless the distant market, however, is large enough to consume considerable current it hardly pays to attempt to supply it. At present the large. electrical groups drawing their power from waterfalls and streams are able to find ready markets for all the current they can generate, and with the growth of the cities supplied it is more a question of increasing their output to keep pace with the developments of industries than to find new distant markets.

Electric Meter Testing.

In the absence of any appropriation with which to establish an electric meter-testing station in New York City, Commissioner Oakley has reached a tentative agreement by which all such meters may be examined at Columbia University. The university will maintain the station and furnish the necessary apparatus if the city will pay half the inspector's salary.

THE MAINTENANCE OF COMMUTATORS AND BRUSHES.*

BY S. LEES.

The subject of the following article may appear, perhaps, to some readers to be rather simple and uninteresting, but it is, nevertheless, a most important one to which too much attention cannot be given if the maximum efficiency and economy in the running of direct-current machinery is to be obtained with the minimum of expense. Even in these enlightened days, there are many central stations of large size (the writer speaks from actual experience) where, while money is literally thrown away on expensive test-room equipments—potentiometers, with their numerous adjuncts, photometers, balances, etc., in fact, no end of standard instruments of various kinds—it is considered quite unnecessary to provide anything in the way of tools for the cleaning and truing up of the commutators.

Formerly, it was usual when a commutator had been allowed to get into such a bad state that running was impossible unless accompanied by a fine display of pyrotechnics, to tide matters over by putting a file on the commutator; as, with many of the older types of machines it was an impossibility to rig up a slide rest and skim up the commutator in position, and to take out an armature of four or five tons weight was often no easy matter—the lay-out of the plant in some of the older stations left much to be desired these things being understood better at the present day—to say nothing of the inconvenience caused through the armature having to be sent to some shop to be turned up, as very few of the stations of 10 or 15 years ago enjoyed the luxury of a lathe.

Nowadays there is no excuse for treating commutators in this barbarous manner, although some engineers still stick to the idea that the presence of slight flats does not necessitate the truing up of the whole commutator. That this idea is quite erroneous may be easily proved by carefully calipering the commutator after the flats have been filed out. The small flats have been removed only to give way to larger ones, thus leaving the whole surface of the commutator very uneven, aggravating sparking by causing the brushes to jump, and resulting in increased wear of both the commutator and brushes.

The writer recalls an experience he encountered about eight years ago at a large electricity works in Yorkshire. The commutators of nearly all the generators (some 17 in number, varying in size from 150 kw. to 600 kw.) were in a very bad state, and one of the writer's first jobs on first taking up duties was the truing up (by file) of the commutators of two of the 150 kw. sets. The machines were of the bipolar type, having three copper gauze brushes to each holder. The brushes of dissimilar polarity had been placed exactly in a line with each other, owing to which the commutator had become worn down in the form of three grooves, the flanges thereto standing up about ¼ in. all round from the rest of the commutator. The sets were direct-coupled, and, viewed from the machine end, ran counter-clockwise, rendering the filing nearly all left-hand work. The works did not boast a lathe, and the machines could not be spared out of service long enough to allow of the armatures being sent away.

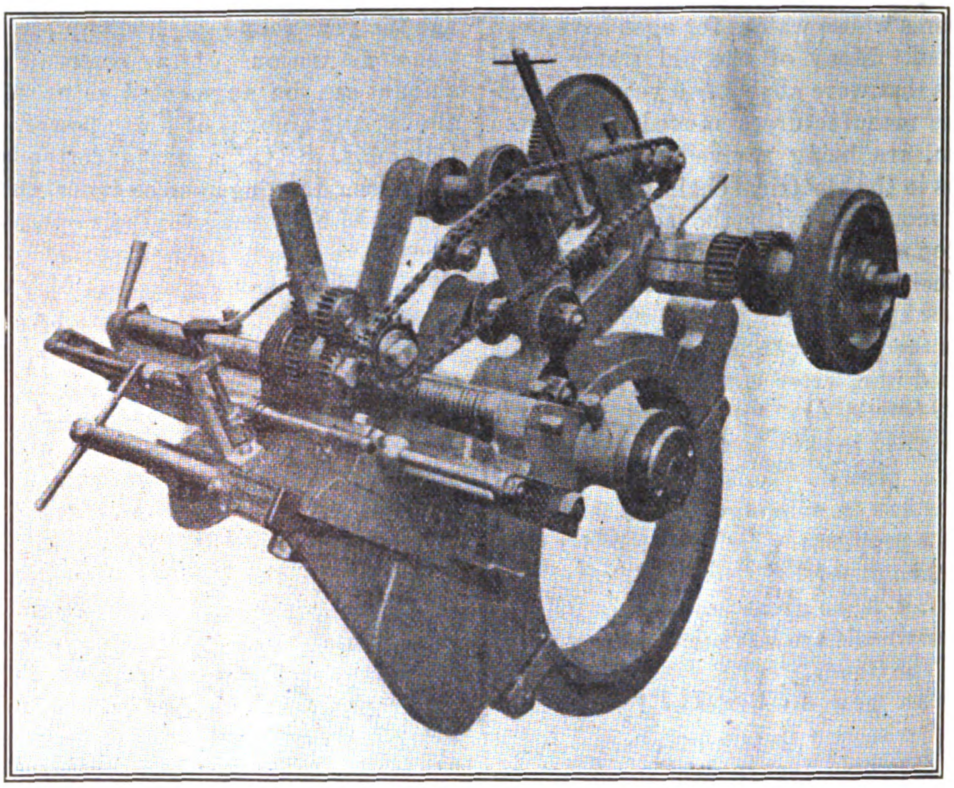


FIG. 1.

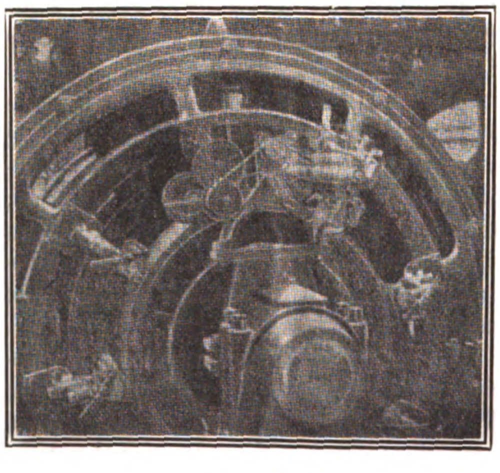


FIG. 2.

Of the two methods of truing up commutators—viz., turning and grinding—the writer is of opinion that, taken all round, grinding makes the most satisfactory job. In order to get the best results by turning, the operator requires to have a thorough working knowledge of turning, and the writer's experience has taught him that a really good mechanic is the exception rather than the rule in most installations, not excepting even central stations. Where possible, it is preferable to true up the commutator in position. Hard-drawn copper as used for commutator bars is queer stuff to work, and as the bars have a tendency to spring when passing under the tool the cutting speed should not exceed about 90 feet per minute. With high-speed direct-coupled sets having engines of the two-crank type—particularly single-acting engines—it is sometimes a rather difficult matter to get even turning at these low rates of speed. A tool-holder to take tool steel of V section is very suitable for commutator work, as, in case of breakage, grinding only is required. Light cuts should be taken as the tool is liable to dig in. After the finishing cut is taken the speed may be increased slightly, and a file run over the commutator. Before finally polishing with emery cloth the commutator should be carefully examined all over and any metal which may be found bridging across the mica insulation between the segments carefully removed. The final polishing is best done with a special tool as described later on.

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*From the "Electrical Engineer," London.

There are two types of commutator grinding machines—viz, (1) driven direct from the commutator to be trued up, (2) driven by belt from separate source, usually a small motor. Figs. 1 and 2, illustrative of type 1, represent the grinding machine of the Phillips Commutator Grinder Company, Limited, of London. Fig. 1 is a general view of an automatic machine having a clamp arrangement for fixing round the brush-rocker journal. Where no rockers are used the same machine can be fixed round the nose of the outer bearing. Distance rings of different sizes are used when necessary to fit various sizes of rockers. When inconvenient the bottom half ring is dispensed with, and the machine is bolted to arms supported from the cover bolts, and when the diameter of the commutator is extra large the arms are raised by means of distance pieces, or they are bolted to the platform of a casting clamped round the nose of the bearing, as illustrated in Fig. 2. The Phillips light hand-feed machine, which is used chiefly for small dynamos (exciters, boosters, etc.), is made to true-up commutators from 3 inch to 9 inch diameter and 6 inch wide (across face). The heavier hand-feed machine is made stronger to carry longer slides to true-up commutators from 6 inch to 12 inch diameter to 10 inch wide. This type of machine is specially suitable for dynamos on board ship (but they can be used otherwise), which, as a rule, are erected close to the bulkheads, allowing but little room for working. In working the grinding spindle is driven direct by means of a specially prepared rubber friction wheel running on the commutator. The grinding wheel moves to and fro across the face of the commutator, and in all except the hand-fed machines is automatically reversed at each end, being so constructed that stops can be set as in a planing machine, grinding the surface right up to the connecting wires and back to the edge. The grinding wheel should, of course, run in the opposite direction to the commutator.

A commutator truing machine possessing some novel features has recently been placed on the market by Jordan Brothers, of New York, U. S. A. It is of the direct-driven type, the grinding wheel spindle being driven by means of a round belt passing round the commutator or armature shaft. The grinding wheel spindle is slotted to allow of lateral movement of the wheel across the face of the commutator. The feed is controlled by hand, the depth of cut being set by means of an eccentric gear. The grinding wheel is specially made for commutator work, as it is claimed that no substance which would be injurious to commutators enters into its composition. The machine is provided with suitable clamps for affixing to the rocker journal or framework of the generator or motor.

Fig. 3 is illustrative of type 2. The emery wheel, A, is fixed on the shaft, B, which is carried by the bearings, C C, supported on the standards, D^1 D^2. The standard, D^1, is provided with a V slide on which it may be traversed across the bar, E, to suit different depths of cut. The base of the slide is carried by the sleeve, F, on which is formed a half nut, G, engaging the screwed end of the rod, H. A handle is fitted to rod H, by means of which the wheel A, can be traversed along the commutator in either direction. The shaft, B, is slotted at M to enable it to travel through the bearing, C, and driving pulley, O; and the bearing standards, D^1 D^2, are telescopic, so as to admit of vertical adjustment for different heights of commutators. In the sketch the machine is shown fixed to the bedplate of the dynamo by an adjustable clamp, P.

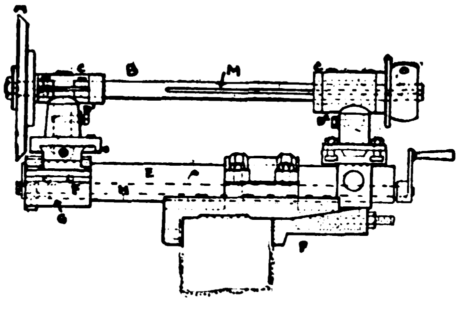

Fig. 3.

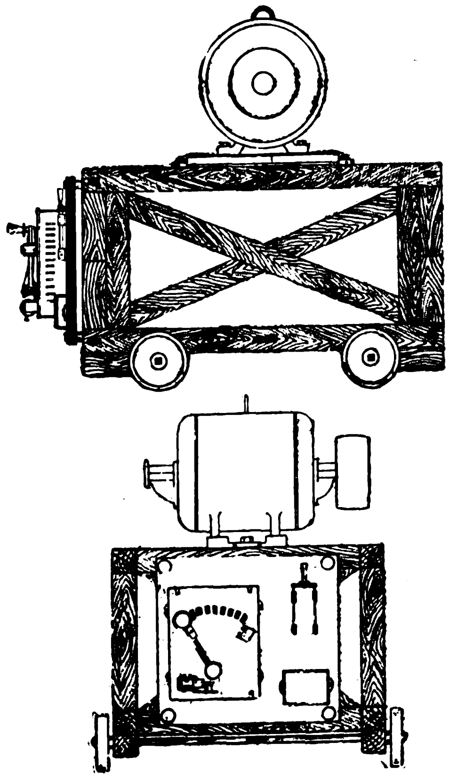

Fig. 4.

The writer experienced some little trouble in getting a satisfactory belt drive with this type of grinder, but finally got over the difficulty by mounting the driving motor, starting switch, etc., on a portable stand, as illustrated in Fig. 4. The framework is built up of 3 inch by 3 inch well-seasoned pitch pine, all joints being mortised and bolted together. The motor is of the protected type, giving 1 BHP., the starting switch being provided with overload and no voltage release coils. The details of the sketch may, perhaps, prove self-explanatory. The compactness and portability of the arrangment will be readily appreciated by anyone who has done much commutator truing, and its advantages over any other method where the driving motor, starter gear, etc., require fixing in position before using each time, are obvious.

(To be continued.)

BACK PRESSURE VALVES.

BY W. H. WAKEMAN.

The value of exhaust steam from engines and pumps for heating buildings, warming water, etc., is appreciated in many more places at the present time than it was a few years ago, but there is chance for missionary work along this line yet in scores of cases.

Exhaust steam is usually impure as it contains some of the oil used to lubricate the internal parts of the machines through which it passed, but it can be purified so that when it is condensed the resulting water is fit for making artificial ice.

Objections are often made to the back pressure usually caused by using the steam elsewhere, but these are not always well taken, because it is frequently unnecessary to cause much back pressure, and in many cases said back pressure does no harm and does not add to the cost of fuel necessary to operate the whole plant.

Wherever exhaust steam is used for useful purposes a back pressure valve should be installed, for it acts as a safety valve and prevents pressure from accumulating that would stop the engine, or damage the light pressure piping sometimes used for this service. There are several kinds of these valves and as their good qualities are not always understood by those who buy them for use under various conditions, a few questions along this line should prove both interesting and instructive.

Some time ago I visited a plant containing a fine Corliss engine, that was well cared for in every respect. The feed water heater was located in the engine room and above it was the back pressure valve. Everybody that came into the room was made aware of this fact by the noise it caused, for every time a puff of exhaust steam came from the engine, (which revolved at a low speed), the valve opened, and between the puffs it closed. It was not provided with a dash pot, or any other device for preventing this noise, hence it was a nuisance.

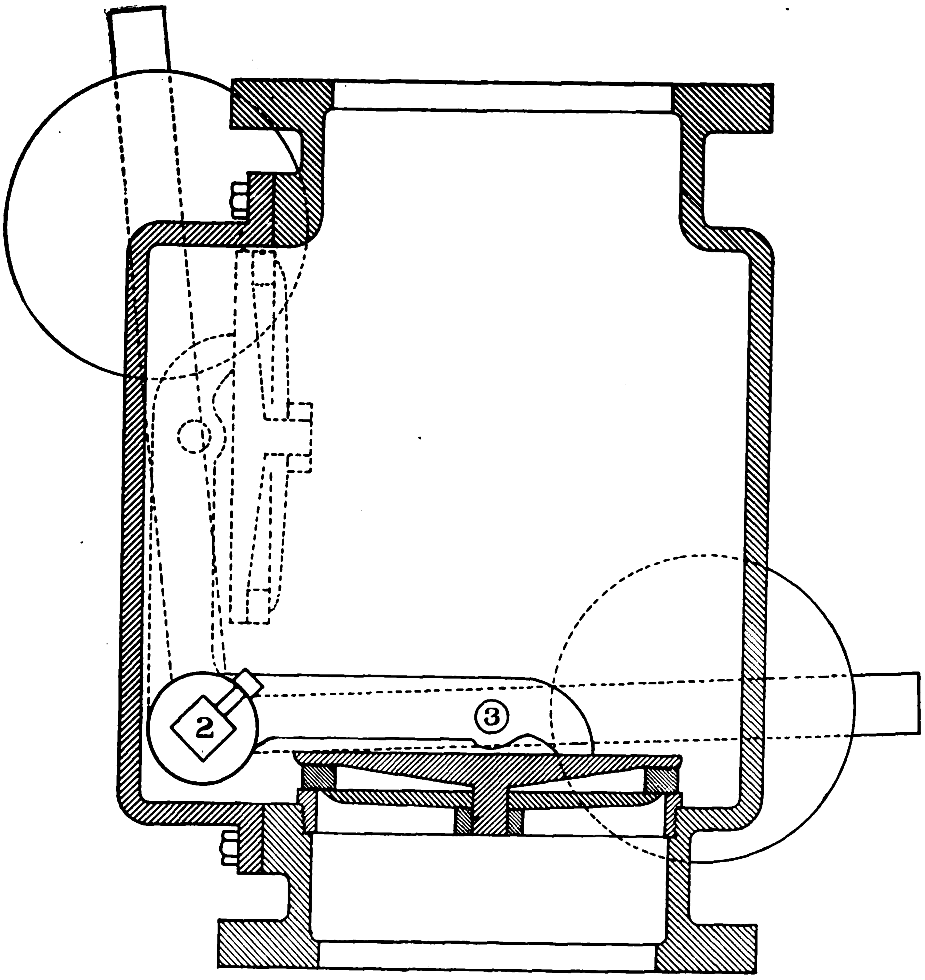

Fig. 1.

While installing an engine with necessary piping in another plant I took good care to specify that the back pressure valve should be noiseless in operation, and it proved so in practice, although the device for preventing it from pounding its seat was extremely simple. Just before the valve closed tight it trapped a small amount of steam which acted as a cushion, bringing the parts together quietly.

I have stated that back pressure is not always detrimental, but valves and exhaust piping ought to be designed so that when steam is discharged into the air as a waste product, it should escape with the least possible friction, for under these conditions back pressure is detrimental in every case.

Some of the back pressure valves in service at the present time can be raised from their seats but a very short distance, giving only a small passage for steam. The valve illustrated in Fig. 1 is in great contrast to this, for when open the cross section of opening is greater than for the straight pipe, consequently it can cause no friction. The full lines show the valve closed, while the dotted lines indicate its position when open. It should be noted that in every case the length of lever outside of the valve casing does not represent the actual leverage brought to bear on the valve. Referring to Fig. 1 the outside lever is hinged at 2 and the apparent length of it is from this point to the center of round weight. This is partially offset by the inside lever which extends from 2 to the center of valve at 3, therefore the real leverage is from 3 to the center of round weight.

This explains the necessity for having such a large and heavy weight on a valve of this kind, even when it is designed to open at a light pressure. When a heavy weight is located near the ceiling of an engine room, it seems to be a constant menace to all who pass by, therefore I have adopted the idea of using a small wire cable, by means of which the weight is located near the floor where it can do no harm if a set screw slips or a cast iron lever breaks.

Fig. 2 illustrates a valve requiring but a small weight to hold it closed against a reasonable pressure. This is due to the fact that pressure acts on two circular surfaces shown in elevation at 2 and 3. Steam entering from the left tends to raise 2 and at the same time presses downward on 3. If both were of the same size, the valve would remain closed even if a high pressure was brought to bear on it, but the greater area of 2 gives this an advantage over 3, consequently the valve lifts, but the weight, (not shown in the cut), is only required to be large enough to balance pressure acting on the difference in area between the two circular surfaces.

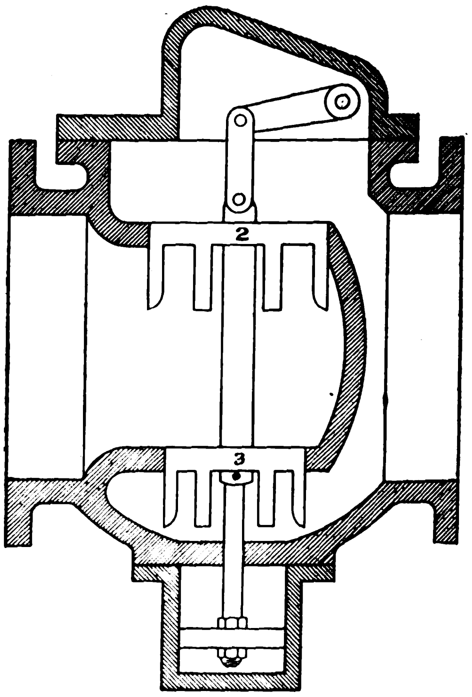

Fig. 2.

As this valve wears, it leaks because no means are provided for overcoming the trouble except to renew the internal movable parts, 2 and 3. When the stem is located in a vertical position as shown, the wear is very slight, for it is almost frictionless.

A dash pot is provided at the lower part into which a piston is loosely fitted. This soon fills with water and as the piston cannot move rapidly in either direction on this account, the valve is practically noiseless in operation.

Fig. 3 is a valve on which there is no external lever, hence no weight either large or small to be cared for. A spiral spring acts on the short arm of a bell crank lever, the long arm of which rests upon the top of valve as shown, or in other words the valve is held to its seat by a spring, the tension of which can be regulated by the set screw at the right hand side. The cut plainly shows the internal dash pot which prevents hammering and clattering as the engine discharges steam in puffs.

When a free exhaust pipe is wanted, the set screw at the left is screwed down, raising the valve from its seat and holding it there.

These three valves represent three principal types now in use, namely, those requiring a heavy weight, those which utilize a light weight and those controlled by springs. Of course the two former could be held in place by springs, but weights are used as a distinctive feature. There is another type in which a weight is used directly on the valve stem which projects through the bonnet for this purpose, thus making it a dead weight valve, but these are not used extensively, and for very light pressures only, therefore they are not included in this article. Those presented are practical types when used as illustrated and are mentioned for the purpose of calling attention to good valves for use wherever it is desired to produce pressure in the exhaust pipe of an engine, and yet provide means for the prevention of excessive pressure, provided all of the steam is used.

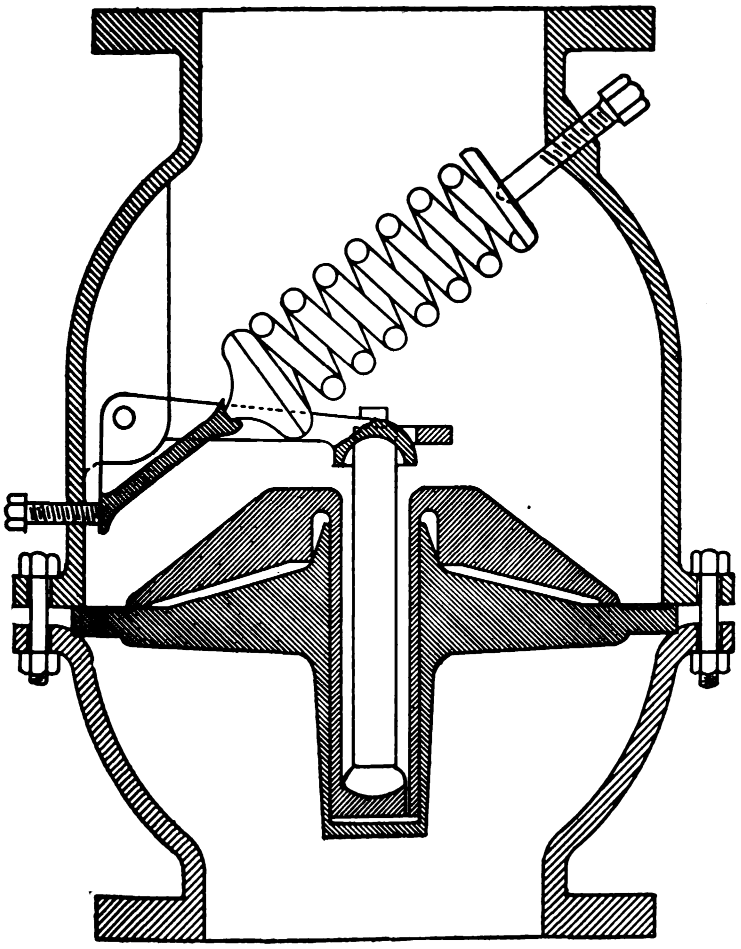

Fig. 3.

WRINKLES.*

EDITED BY H. C. ABELL.

A Method of Repairing Damaged Insulation Between Damaged Commutator Bars.

A commutator trouble that sometimes worries the operators of direct-current generators, and motors is a short-circuit between adjacent commutator bars, which gradually burns down deeply into the mica insulation, and ends eventually in a burn-out of a section of the armature winding. The trouble may disappear for a short time if the burned insulation is scraped away, but carbon dust from the brushes soon accumulates and bridges across from bar to bar, and the difficulty continues.

A permanent cure may be effected by digging out all the dirt and burned mica and filling the cavity with a thin paste composed of litharge and glycerine. The commutator should then be heated at this point with a soldering iron or blow torch, baking the paste to a hard compound, which can be filed off smooth and even with the commutator surface.

It is very essential to absolutely remove the short-circuit before applying the paste, and it is best to disconnect one of the bars from the armature winding and test across the insulation, using a voltmeter or incandescent lamp as an indicator. Holes three-quarters of an inch deep have given no trouble since receiving this treatment.

CLEVELAND ELECTRIC ILL. CO.

Protecting Standard Indicating Instruments.

Primary indicating standard instruments used for checking working standards on meter test racks are in one instance well protected from stray magnetic fields and from mechanical injury, by being supported each inside of an iron box over 30 inches square. The boxes are made of boiler plate, welded seam, top and bottom bolted tightly to side wall. A wooden partition horizontally through the box gives support for the instruments. Low-candle-power electric lamps, inside the boxes, light the instrument scales. A rectangular cardboard tube painted a dull black, extending from slightly over the instrument scale to a slot in the top of the box, eliminates reflection and protects the eyes of an observer from the rays of the lamps. The boxes are mounted on castors for ease in moving to switchboard type working standards to be checked.

CLEVELAND ELECTRIC ILL. CO.

Handy Galvanometer for Potentiometer Work.

For some time we were bothered to get a galvanometer for use with a potentiometer in a location where there was too much vibration for a D'Arsonval suspension galvanometer. The ordinary small pivot galvanometer was not sensitive enough for the work. We obtained a student's miscroscope, removed the mirror and table, and put an extension on so that the lenses could be brought over a pivot galvanometer. With this arrangement, which is always ready for use regardless of ordinary vibration, we can use the potentiometer for measurements to two-thousandths of one volt.

C. R. BROWN, BOSTON, MASS.

Switchboard for Voltmeter Testing.

The accompanying diagram shows the connections of a switchboard used in connection with voltmeter testing in the laboratory of the Edison Electric Illuminating Company, of Boston, which embodies several features that have proved very useful in facilitating rapid work.

Three batteries are used as shown on the left of the diagram. The posts labeled "D. C. system" are for a 220-volt charging circuit for two of the batteries. Double-pole, double-throw switches, c and d, when thrown to the left charge the "old battery" and "new battery," the other battery being charged from another board. When thrown to the right they put the batteries at the service of the operator. The two posts marked "standard meter" connect with a direct-current standard voltmeter; an alternating-current standard may be put in on the two posts marked "D. C. or A. C. meter." The posts marked "to rheostat" are connected to the outsides of two rheostats placed in series, one having a resistance of 1,500 ohms in 30 steps, and the other having a resistance of about 100 ohms in very small steps for fine regulation. The insides of these rheostats are connected to the posts marked "resistance," which, it will be noted, connect with switches a and b, so that three or six 16-cp, 110-volt lamps may be thrown in series with, and between, the two rheostats. The moving arms on the rheostats are connected to the posts marked "from rheostat." The switch g is connected to the potential transformer at the top of the board. This is fed from a 110-volt circuit, and the secondary taps give 150, 300 and 600 volts, respectively, from left to right as connected to g. Just below the transformer are three sets of three 16-cp incandescent lamps. The left-hand set is in multiple and is used in charging the batteries; the other two sets have been referred to already.

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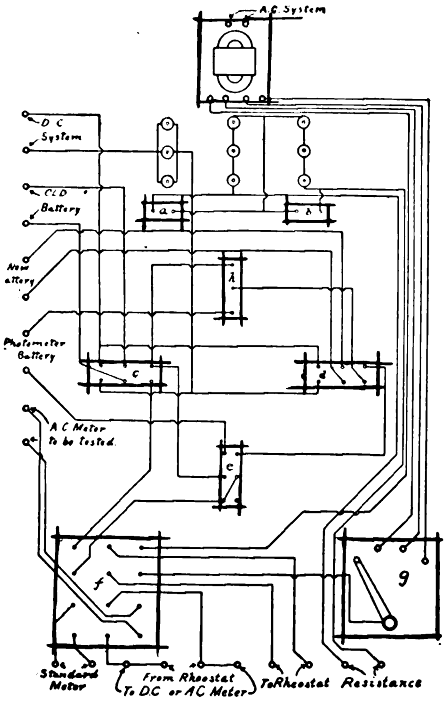
*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.



Switchboard Connections.

In checking a voltmeter the procedure is as follows: To get 110 volts, switch c is thrown to the right, the meter connected to the posts as indicated, and the rheostat removed to the required point to give 110 on the standard, which is a direct-current meter. Here switch e is down and h up. If we wish 220, d is thrown to the right, e is thrown up and either a or b opened to protect the rheostat against overload, and the rheostats adjusted to the proper point. For 600 volts, switch h is thrown down and a and b are opened. In all direct-current work switch f is thrown to the left. A reversing switch in the line to the meter to be checked will be found useful.

This board lends itself very well to the checking of alternating-current meters, using a hot-wire meter as a standard. This may be connected to the posts marked "to D. C. or A. C. meter" and the alternating-current meter to be checked connected to the posts on the left near the battery posts. The hot-wire meter may be set anywhere by the method given for direct-current meters, and then by throwing f to the right everything but the direct-current standard is cut over to alternating-current, and the transformer switch g can be set to give approximately the same voltage as the batteries in use.

C. R. Brown, Boston, Mass.

* * *

To Maintain Approximately Constant Voltage When Throwing One or More Generators In or Out When Operating In Parallel With a Generator Having the Same Source of Exciting Current.

As the exciters here are driven by a small, independent turbine, we have found that in switching on the field-current of a second generator, though with all rheostat resistance in circuit, a very objectionable disturbance is made in exciter speed and voltage, and, in spite of the best possible switchboard attendance, in the voltage on first generator. Besides this, we consider that in the case of having the second generator connected to a separate line and sets of transformers, it is objectionable to have so large a percentage of full voltage, as is thus obtained, switched on suddenly.

To overcome this difficulty, we use a water-rheostat connected to a double-throw switch, as per diagram, so that it may be inserted in a field-circuit of either of two generators or be short-circuited. We thus obtain a very gradual rise in voltage from zero to normal, and a gradual decrease from normal to zero, in starting up, or closing down a second generator, line, and set of transformers, without objectionable disturbance of voltage on first unit, and with a minimum of potential strain on second outfit.

G. Hartman, St. Gabriel, P. Q.

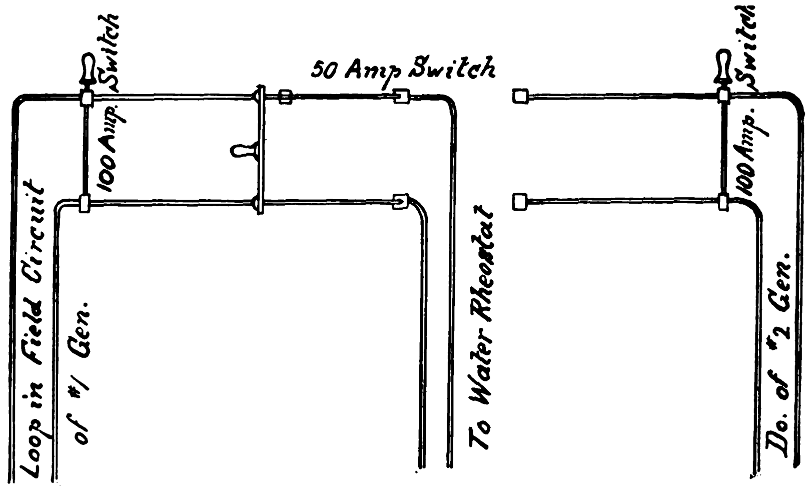


Diagram of Connections.

* * *

A Large Bavarian Power Scheme.

An interesting opportunity of utilizing water power in the Bavarian Alps has been reported upon by a Swiss engineer, Mr. Jeanjaquet, in conjunction with a German engineer, Mr. Schmick, of Darmstadt. If the scheme is carried through, it is estimated that sufficient electrical energy will be obtained from the water to drive the greater part of the Bavarian State railways. The idea is to utilize two lakes which are situated in the mountains near each other, but with separate watersheds. They each discharge into the River Isar, but by separate outlets. The lake which will be used as reservoir is named Walchen. The surface of the water in this lake is about 6½ square miles, and the maximum depth of the water in it is over 600 feet. The height of the lake above sea level is 2,635 feet. The lake of Kochel, into which the water can be diverted, is about 660 feet lower, and the direct distance between the two lakes is only some 2,200 yards. A tunnel would have to be made through the hill which divides the two lakes. The scheme, however, goes further than this.

The watershed draining into Lake Walchen is not a very large one, and would not provide the desired power regularly.

A few miles south of this lake there is the River Isar, which in its upper reaches flows from west to east. The level of the river is considerably above that of the lake, and hence it is proposed to divert a certain portion of the water into the lake by means of another tunnel through the dividing hills. This water can then be stored in the lake, which will form a splendid natural reservoir. This, combined with the high fall obtainable, makes the scheme an exceedingly attractive one, and we trust that it will be sanctioned and the works constructed. The lower portion of the River Isar, between the point where it would be diverted into the lake and Munich, is exceedingly rapid, and contains a number of falls which have already been harnessed for industrial purposes. This scheme, however, could be so arranged as not to interfere with these, as the volume of water passing down the river would be rendered more uniform than at present in consequence of the storage reservoir described above. Electrical Engineer, London.

A Dollar Well Invested.

Electricity Newspaper Company.

Gentlemen: As my subscription to your valuable paper, ELECTRICITY, expires on September 20, I send herewith a money order for $1, renewing my subscription for another year.

When I sent in my subscription last year, I was somewhat doubtful as to the value of the investment, but I have since found that that dollar has paid itself back many times over. I have a number of fellow-workmen who would like to get some understandable reading-matter on electricity. I inclose, on separate sheet, a list of them—employes of the Bethlehem Steel Company, Electrical Department, and I think it would be of interest to you to send them assorted samples of ELECTRICITY, and some energetic circular letters. Yours respectfully,

ROGER P. HELLER,

Bethlehem, Pa., Sept. 9. 1905.

An Interesting Booklet.

An attractive catalogue has recently been gotten out by the Wallace Barnes Company of Bristol, Conn. This booklet, which contains some 35 pages of matter, describes and illustrates the many types of springs manufactured by this well known concern. The catalogue contains among other things several wire tables which cannot help but be of value to every one engaged in the electrical or engineering profession.

American Institute of Electrical Engineers.

The next meeting of the Institute will be held at the Assembly Room, New York Edison Company, 44 West 27th street, New York, on Friday, September 22, at 8 P. M. The following papers will be read and discussed: "Air-Gap Flux in Induction Motors," by A. S. Langsdorf; "Standardization of Inclosed Fuses," by H. O. Lacount.

A Two in One Transformer.

A bulletin has just been issued by the Wagner Electric Manufacturing Company, of St. Louis, describing the construction and operation of the so-called "two in one lighting and motor transformer," recently brought out by this well-known concern. This type embodies literally two transformers in one, in that the design is not only superior for lighting service, but adequate and eminently satisfactory for either motor service or combined lighting and motor service. While the advantage of such a transformer is pre-eminently one of interchangeability, and therefore less confusion in installation, as will readily be seen, there is also great advantage in that a minimum reserve of transformer stock is required.

The bulletin in question is fully illustrated, and a copy will be sent free of charge to all parties interested.

Japanese Water Power Enterprises.

A Japanese paper the "Electrician's Friend," published in Tokio, states that there are two water power enterprises on foot. One is known as the Tokio-Denriyoku-Kaisha scheme, and involves the construction of three power stations, having an aggregate capacity of 43,600 hp. These are to be built on Katsura and Sagami rivers, and will be equipped with 24,000 hp. to begin with. The other scheme is known as the Tokio-Dento-Kaisha scheme. One power station of 20,000 hp. is to be built, using a 300 foot head of water on the Katsura river. Electrical energy will be transmitted to Sinjiku, 50 miles away.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPT. 12, 1905

Electric Railways and Appliances.

799,110. Cover for Third Rails. William G. Taylor, Forest City, Pa. Filed Dec. 3, 1904.

799,165. Car-Fender. Alfred Jobin, Winnipeg, Canada Filed Feb. 4, 1905.

799,213. Trolley Catcher and Retriever. Charles F. Wilson, New York City. Filed Jan. 24, 1905.

799,419. Trolley. William S. Tichenor, Owensville, Ind. Filed Feb. 4, 1905.

799,516 17-18-19-20-21-22-23-24-25-26-27-28-29. Train Lighting System. William L. Bliss, New York City, assignor to the Bliss Electric Car Lighting Company, Milwaukee, Wis. Filed April 27, 1904 and June 16, 1904.

Electric Lights and Appliances.

799,420. Lamp-Socket. Julius C. Tournier, Schenectady, N. Y., assignor to the General Electric Company. Filed Nov. 27, 1903.

799,451. Starting Apparatus for Vapor Electric Lamps, Clyde J. Coleman, Rockaway, N. J., assignor of one-half to Sidney Aronstein, New York City. Filed Feb. 7, 1904.

Electrical Machinery and Apparatus.

799,035. Reversing Mechanism for Motors. Abe L. Cushman, Concord, N. H., assignor of one-half to Benjamin A. Kimball, same place. Filed May 31, 1904.

799,050-052-053. Circuit-Controller and Method of Controlling Electric Circuits. Peter C. Hewitt, New York City, assignor to the Cooper-Hewitt Electric Company. Filed March 7, March 20 and Aug. 10, 1903.

799,064. Pneumatic or Hydraulic Transmission of Electric Power. Hans Kowsky, Hastings on-Hudson, N. Y. Filed Sept. 5, 1902.

799,136. Electrically-Controlled Motor. Henry Bezer Westfield, N. J. Filed Sept. 4, 1901.

799,177. Power-Transmission System. Victor Martinetto, Chicago, Ill., assignor of one-half to Harry L. Barth, same place. Filed Feb. 18, 1904. Renewed Feb. 13, 1905.

799,264. Motor Suspension for Electric Motors. Edward D. Priest, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 11, 1905.

799,305. Magneto-Electric Generator. Robert C. Crouch and John A. Titzel, Sr., Newcastle, Pa. Filed Nov. 19, 1904.

799,368. Electrical Sparking Ignition System for Gas-Engines and Starting-Switches Therefor. Vincent G. Apple, Dayton, O. Filed Nov. 9, 1903.

799,377. Cut-Out for Electric Heaters. Johannes Harden, Schenectady, N. Y., assignor to the al Electric Company. Filed Dec. 1, 1904.

799,393. Circuit-Breaker for Explosive-Engines. Ralph M. Lovejoy, Meredith, N. H. Filed Jan. 30, 1905.

799,452. Relay. William W. Coleman, Edgewood Park, Pa., assignor to the Union Switch & Signal Company, Swissvale, Pa. Filed April 7, 1905.

Telephones and Telephone Apparatus.

799,137. Transmitter-Arm. Jules A. Birsfield, Rochester, N. Y., assignor to Stromberg-Carlson Telephone Manufacturing Company. Filed Feb. 13, 1905.

799,146. Circuit-Changing Apparatus. Merritt S. Conner, Chicago, Ill., assignor to Stromberg-Carlson Telephone Manufacturing Company. Filed Mar. 17, 1904.

799,160. Switching Appliance for Telephone-Exchanges. Carl M. Hedman, Chicago, Ill., assignor, by mesne assignments, to Stromberg-Carlson Telephone Manufacturing Company. Filed May 22, 1902.

799,205. Telephone-Receiver Casing. Axel R. Thollander, Chicago, Ill. Filed Nov. 10, 1904.

799,346. Calling Device for Automatic Telephone-Exchanges. Frank A. Lundquist and John K. Norstrom, Chicago, Ill., assignors to M. E. Richardson trustee, Sterling, Kan. Filed Aug. 27, 1900.

799,585. Electric Generator for Telephone Systems. Enos B. Willix and John Young, Mount Vernon Iowa. Filed Feb. 25, 1905.

Miscellaneous.

799,049. Lightning-Arrester. Peter C. Hewitt, New York City, assignor, by mesne assignments, to Cooper Hewitt Electric Company. Filed May 16, 1902.

799,191. Electrical Attachment-Plug. Bert E. Salisbury, Syracuse, N. Y., assignor to Pass & Seymour, Solvay, N. Y. Filed July 20, 1904.

799,237. Telegraphy. Sterns F. Jones, New York City, assignor of one-half to Postal Telegraph-Cable Company. Filed Apr. 6, 1905.

799,392. Telegraph-Transmitter. William H. Leonard Mount Vernon, and Joseph H. Lewis, New York City. Filed Dec. 14, 1904.

799,402. Electroplating Apparatus. Louis Potthoff, Brooklyn, N. Y. Filed Apr. 30, 1904.

799,422. Watchman's Recording and Alarm System. Albert E. Waggoner, Grand Rapids, Mich. Filed July 13, 1903.

799,433. Support-Fastener for Lightning-Conductor Carl Bajohr, St Louis, Mo. Filed Mar. 29, 1905.

THE TELEPHONE WORLD.

Planning Telephone Union.

As a sequel to the important meeting of the National & Interstate Association of Telephone Companies in St. Louis, Mo., last year, it is reported that a giant telephone merger of all the Independent telephone lines has been formed with the startling capitalization of $200,000,000, in which merger a syndicate of St. Louis magnates plays quite a distinguishing part. The details were arranged at a meeting held in Pittsburg last week at which James G. Splane, president of the Pittsburg & Allegheny Telephone Company, said: "We will meet in St. Louis next week to go over the result of the inspections and prepare for the ultimate union of the telephone companies, only in so far as the long-distance business is concerned. How soon the consolidation will take place I am unable to say, as there are thousands of details that must be gone over before it occurs." It is the plan of the Independent Association to build connecting links between the systems included in the deal. It is expected that eventually the Keystone Telephone Company, which is an active competitor of the Bell Company in Philadelphia, will join the movement. This will mean a new trunk line between Pittsburg and Philadelphia, going through Johnstown, Harrisburg, Lancaster and other points on the main line of the Pennsylvania Railroad.

The St. Louis men interested are Adolphus Busch, the millionaire brewer; Breckenridge Jones, vice-president of the Mississippi Valley Trust Company; John D. Davis, general counsel and vice-president of the Mississippi Valley Trust Company; August Gehner, president of the Gehner Realty & Investment Company; William F. Nolker, brewer and capitalist; C. M. Forster, first vice-president of the St. Louis Brewing Association; Herman C. Stifel and a number of others.

The Wisconsin Telephone Company has placed a local exchange on the floor of the chamber of commerce in Milwaukee, Wis., through which all the lines of the grain operators on the floor are connected direct with the general system, as well as with each other.

The China Lake Telephone Company, of which J. W. Thompson is manager, is stringing poles and cross arms in the lake road from South China to China, Me., a distance of seven miles. This addition to the line will accommodate a large number.

A movement is on foot in Brushton, N. Y., for the building of a local telephone line, the cost of construction and maintenance to be paid pro rata by each subscriber. C. A. Wardner, electrician, has agreed to build the line and install the instruments, at a cost not exceeding $15 for each instrument, providing a sufficient number subscribe.

A meeting has been held recently in Fowler Col., to consider a mutual telephone system project. After considerable discussion as to conditions it was decided that the plan was feasible. Committees were appointed to gather data for a report to be made at a meeting to be held soon.

Telephone Deal.

Postmaster Frank A. Knapp, of Bellevue, O., has purchased a controlling interest in the local telephone company and the Bellevue Home Telephone Company. The Local Telephone Company has 4,200 telephones installed, and 200 miles of toll lines in Huron and Crawford Counties, with exchanges in 16 towns. With Mr. Knapp are associated some of the leading Independent telephone men in the State. By the deal Mr. Knapp and his associates acquire control of telephone property representing an investment of $400,000.

York Company Doubles Stock.

The stockholders of the York, Pa., Telephone Company at a recent meeting voted unanimously to increase the capital stock of the corporation from $200,000 to $500,000 for the purpose of placing the wires of the company's system underground, making important rural extensions to the system, and adding general improvements. Charles H. Lidlie, electrical engineer, of St. Louis, Mo., has been engaged to prepare plans for a conduit system for the county.

A. B. Hunt, speaking of the prospects for securing a franchise from the Omaha, Neb., city council for an Independent telephone company, says that he and the two other promoters of the company, Messrs. T. E. Parmelee and T. H. Pollock, certainly expect the franchise will be granted in due time. "We are not seeking to rush things particularly," said Mr. Hunt. "We have made such a proposition that we are entirely confident the councilmen will look on it with favor. The Independent systems are proving the lever to alter rates that have been fixed for many years and to secure much better service for business men and farmers. The laboring element gets in on the money spent for buildings, equipment, repairs and betterment. Every new Independent company means many thousands of dollars of money expended for labor and material every year."

At the recent meeting of the Gadsden, Ala., city council a franchise was granted to W. H. Crumb and associates to erect a telephone system in that city, work to commence within six months and the entire system to be completed within 18 months. The new company is given a franchise over all the streets, alleys and highways of the city, It states that the rate for business houses will be $3.50 per month, and for residences $1.75 per month.

Competition lately induced the Chicago, Ill., Telephone Company to offer to furnish the city telephone equipment at one-third the price it formerly had charged. The city has not accepted the Chicago Telephone Company's offer, but has taken it under consideration.

The Santa Fe, N. M., Telephone Company has been granted a franchise for the term of 25 years.

Lewis Blades has applied for a telephone franchise in Hope, Ind.

The Stamper Union Telephone Company has obtained a franchise in Benton, Ill.

Medal for Telephone Company.

The International Exposition of Social Economy, which is being held at Liege, Belgium, notified S. M. Greer, private secretary to U. N. Bethel, general manager of the New York Telephone Company, that the company would receive a silver medal in recognition of its welfare work among its employes.

The award was the first made to an American company. The exhibit of the New York Telephone Company included illustrations of its work relative to the care of the telephone girls.

Telephones to Check Forest Fires.

For the better protection of the forest reserves against fire, the forest service, in co-operation with the Weather Bureau will install a system of telephone lines and stations on them as rapidly as possible. The first system will be installed on the Big Horn forest reserve in Wyoming.

News from Oswego, N. Y., states that the Ontario Telephone Company has filed with the county clerk a mortgage for $200,000. The mortgage is given to the United States Guaranty & Trust Company of New York, and was filed by Elisha B. Powell, attorney for the company. The mortgage is given to provide for the proposed improvement of the lines of property. The mortgage tax on the issue will be $1,000.

The Retail Merchants' Association of Norfolk, Va., will ask the city council at its next meeting to take some steps to secure a better service from the Southern Bell Telephone Company or suggest any remedy that lies in its power to produce such a result.

The Cape May, N. J., city council at its monthly meeting passed to its third and final reading an ordinance requiring the Delaware & Atlantic Telephone Company to place its wires underground, at least 2,000 feet to be so placed within a year.

Cleveland and Cincinnati, O., will soon be connected by telephone. The Big Four will extend its system, which was installed between Cleveland and Galion and between Galion and Bellefontaine, eight months ago. The plan now is to install telephone service over the telegraph wires from Galion to Cincinnati, also from Springfield to Sandusky.

The Hudson River Telephone Company has applied to the board of trustees of Malone, N. Y., for the right to put conduits underground for conveying its wires through the principal streets.

The New Long Distance Telephone Company has been granted a 25-year franchise in Frankfort, Ind.

The work on the Independent telephone system in Mexico City, Mex., is being pushed rapidly.

The Canfield Independent Telephone Company is extending its lines to Ellsworth, O.

Independent telephone systems are making rapid progress in Seward County, Neb.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Addison, Mich.—This village has decided to have an electric lighting plant and the contract for a first-class plant was awarded to G. F. Avis, of Hudson.

Alexandria, Va.—This city has an electric light plant. It is now promised to sell the electric plant and to give the purchaser, who will be expected to enlarge the plant, the monopoly of selling electric light and power in the city. It is understood that there will be two bidders.

Ashland, Va.—The Virginia Light & Power Company has been incorporated to operate an electric light and power plant, with a capital stock of $100,000. H. W. Anderson is president.

Clinton, Tenn.—The Clinton Waterworks, Electric Light & Power Company will erect a power house 40 x 60 feet. William B. Crawford, of Oliver Springs, Tenn., is engineer and general manager.

Daytona, Fla.—Three new dynamos will soon be added to the electric light plant here, at a cost of $20,000.

Dexter, Me.—The Dexter Electric Light Company has sold its plant and business to N. Curtis Fletcher, of Boston.

Eagle Pass, Tex.—The Texas-Mexican Electric Light & Power Company has increased its capital stock from $20,000 to $40,000.

Fort Worth, Tex.—George W. Armstrong has secured a franchise to operate electric light, gas, steam, heat, hot water and oil plants.

Gilliam, Mo.—The Gilliam Electric Light & Power Company has been incorporated with a capital stock of $5,000, to operate an electric light and power plant. The incorporators are David C. Burton, J. E. Kirk, A. W. Deis and others.

Glenwood, Wis.—The proposition to bond this city for an electric light and waterworks plant was lately carried.

Gonzales, Tex.—The Citizens' Electric Light & Power Company lately increased its capital stock from $5,000 to $10,000.

Hermon, N. Y.—The Hermon Electric Light Company, capitalized at $15,000, has been incorporated by James H. Cullimore and William G. Popple, both of Hermon, and George N. Popple, Oswegatchie.

Marshalltown, Ia.—The city council is considering improvements in the city's lighting system. New machinery will probably be installed.

O'Neill, Neb.—W. A. Loudon, an electrical and mechanical engineer of Chicago, and connected with one of the largest firms in that city, is here trying to interest the council and citizens in the installation of an electric lighting plant.

Owensville, Mo.—This city is to have an electric light plant. Peter Helling is interested in the enterprise.

Pawhuska, Okla—The Pawhuska Electric Light, Ice & Water Company has been incorporated with a capital of $25,000, by J. W. McLoud, of Little Rock, Ark.; Beeks Erick, of Fort Wayne Ind.

Pierre, S. D.—The city council has decided to put in an an incandescent electric lighting plant, to be operated by waste water from the city wells, tests showing that they can develop more than enough power from this source for the operation of such a plant. There has been a demand for such a lighting system for a long time and the city now intends to meet that demand.

Rockmart, Ga.—Enterprising citizens here have decided to have electric lights for this city. A subscription for stock was lately started with a view to raising $5,000 for electric lights, and the stock has all been taken. R. R. Beasley is the moving spirit in the matter.

Roseville, O.—The Clay City Electrical Company, incorporated with a capital of $10,000, will operate a light and power plant.

Salem, O.—A deal of considerable importance was recently announced in the sale of the entire plant and holdings of the Salem Electric Light and Power Company to E. E. Beam, of Cleveland, and S. D. Gilbert, of Cincinnati.

Topeka, Kan.—The new Edison Company is preparing to spend about $200,000 in extensions and improvements on the Topeka electric light plant. L. E. Myers is at the head of the company.

STREET RAILWAYS.

Bloomington, Ind.—The county commissioners have granted a franchise to the Wabash & Southeastern Traction Company.

Bluffton, Ind.—The Wells County Commissioners lately granted a franchise to James West, the chief promoter of the Portland Montpelier & Huntington electric line, to make a short connection between these three cities.

Dayton, O.—A new traction line, which will connect this city and Connersville, Ind., will enter from the southwest. It will be built by the Dayton Southwestern Traction Company.

Dubuque, Ia.—After discussing plans and making several preliminary surveys an interurban electric railway connecting this city and Platteville and other Wisconsin towns will be a reality in the course of a year.

East Liverpool, O.—The plans have been made to build an electric line from Youngstown to this city, a distance of 50 miles. The construction, it is believed, will cost at least $1,500,000.

Frackville, Pa.—The borough council lately granted the Tamaqua & Pottsville Electric Railway Company a franchise through this borough.

Lowell, Mass.—Extensive plans for a new trolley line from this city to Boston, independent of the Boston & Northern, and with prominent Boston and Maine officials in it, are rapidly approaching completion.

Marshall, Ill.—The city council has passed an ordinance granting a franchise to T. N. Lakin and C. B. Sonemanan for an electric line from East St. Louis to Terre Haute.

Orleans, Ind.—It is announced that work will shortly begin on the new electric line between the Springs and Louisville.

Palestine, Tex.—The chances are very good for the construction of an electric line from this city to Corsicana.

Puyallup, Wash.—The trustees of the Puyallup Valley Traction Company recently held a meeting here and discussed plans for the immediate construction of the trolley line from this city to Tacoma.

Sisseton, S. D.——There is a project on foot to build an electric line from this city to Browne's Valley, Minn., thence to Hankinson, N. D. The promoters of the scheme reside in this city. H. S. Morris is cashier, and J. A. Rickert president.

Syracuse, N. Y.—The Syracuse, Lake Shore & Northern Railroad Company has been formed here to operate a street surface electric road 15 miles long from this city to Baldwinsville. Its capital is $2,250,000, and directors are H. S. Holden, C. M. Warner, A. K. Hiscock, William Nottingham and L. C. Smith, all of Syracuse.

Wellsburg, W. Va.—It is belived that a traction line will, in the near future, be built to Bethany.

Winchester, Ill.—Ground was lately broken for the new electric interurban railway which is to be built between this city and Petersburg.

BIDS WANTED.

Albany, N. Y.—Bids will be received until September 27, by the State Commission in Lunacy in this city, for an engine, generators, switchboard and motors, feed cable and wiring, steam piping and connections, at the Utica State Hospital.

Washington, D. C.—The Interior Department is inviting sealed proposals until November 1, at which time they will be opened at the office of the electrical engineer, United States Reclamation Service, 398 Pacific Electrical Building, Los Angeles Cal., for furnishing complete, f. o. b., bidders' works, one or more alternating current, 900 kw., 25 cycle generators; one or more 100 kw. direct current generators, for exciter, and one switchboard containing one panel for generator and one panel for exciter, for use in the Roosevelt power house, Salt River Project, Arizona. Bidders can obtain full particulars on application to the chief engineer of the Reclamation Service of this city, or to O H. Ensign, electrical engineer, Pacific Electrical Building, Los Angeles. —The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until October 10 for furnishing at the New York Navy Yard and at the works of the Fore River Shipbuilding Company, Quincy, Mass., the New York Shipbuilding Company, Camden, N. J., and the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., a quantity of elevating, rammer and ammunition hoist electrical equipments. Applicants for blank proposals should ask for schedule 143, which can be obtained on application to the Bureau or to the Navy Pay Office in New York. Specifications can be obtained by applying to the Bureau of Ordnance, Navy Department, Washington, D. C. The Bureau is also inviting sealed proposals until October 3 for furnishing Eastern Navy Yards with the following supplies: Schedule 134, battery cells, steel conduit, wire and miscellaneous electrical supplies. On October 10 the Bureau will open bids for furnishing Southern Navy Yards with the following: Schedule 137, incandescent lamps, conduit fittings, bell wire, insulating tape. Blank proposals will be furnished on application to the Bureau, and those for Eastern yards can also be obtained at the Navy Pay Office in New York.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 16@16¼c.; Lake 16@16¼c.; casting, 15¾@16c.

The General Electric Company has declared a regular quarterly dividend of 2 per cent. payable October 16.

Mr. J. J. Mitchell, the well-known financier, says that in his opinion a settlement of the Chicago traction problem will be reached in the next 60 days.

The Western Union Telegraph Company has declared a regular quarterly dividend of 1¼ per cent., payable October 16.

The directors of the Boston & Suburban Electric Company have declared a regular quarterly dividend of fifty cents per share, payable October 15.

The Interborough Rapid Transit Company of New York has declared a dividend of 2 per cent., payable at the office of August Belmont & Co., on October 2.

Stone & Webster of Boston report that semi-annual dividends of $3 per share will be paid on the preferred stock of the Savannah (Ga.) Electric Company and of the Seattle, (Wash.) Electric Company on October 2.

The annual meeting of the stockholders of the Thirty-Fourth Street Crosstown Railway Company, Forty-Second Street & Grand Street Ferry Railroad Company, Central Crosstown Railroad Company and Fulton Street Railroad Company, all of New York, will be held on October 3.

Rumors have it that the traction "deal" in this city will be taken up at once and pushed to completion. The character of the alleged deal does not seem to be very generally known, the principal view of it being that it is a deal between the Metropolitan and the Interborough. This, according to information which comes from a reliable source, is an error.

Stone & Webster of Boston have added to their properties the Northern Texas Traction Company of Fort Worth, Tex. This company comprises the street railway lines in Fort Worth, and the high speed interurban line between Fort Worth and Dallas, a distance of 35 miles.

According to latest reports the Chicago Electric Traction Company has been sold to W. S. Read, of Chicago. Details of the transaction are not obtainable. Mr. Read, who organized the syndicate which purchased the holdings of the Chicago & Southern Traction Company, is a well known financier and promoter.

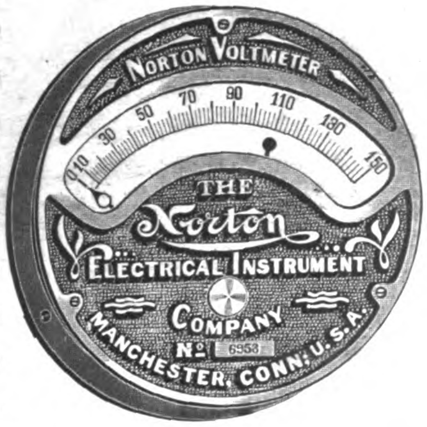
A dispatch from Lexington, Ky., says that J. Levering Jones and Chandler Brothers of Philadelphia have bought the Lexington Street Railway & Light Company for $2,000,000, the Blue Grass Traction Company, for about $2,600,000 and the Frankfort Railway & Light Company for about $300,000. They have bought additional public utilities, making a total purchase of about $8,000,000. The property will be greatly extended.

The Manhattan & Long Island Railroad Company of New York City was incorporated on Thursday last with a capital of $10,000,000, to operate an electric railroad, eighty miles long in Greater New York and Long Island. The road is to run from Long Island City to Northport. The directors are Edward Mackey, D. T. Meyer, H. H. Bowtell, Samuel Y. Sauber, Franklin M. Walter and George F. Macardle of New York City; Robert M. Stockwell of Yonkers, A. Parontaud of Brooklyn and Henry Guinard of Watchung, N. J.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Sept. 19
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	215½
Manhattan Elevated Railway	164
Metropolitan Street Railway	127
Metropolitan Securities	80½
Ninth Avenue	197
Third Avenue	127¼
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	67½
Brooklyn City Railway	239
New Orleans Railway	36½
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81¾
Philadelphia Traction	101
Union Traction	61⅝
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	16
do. do. do. pref	60
West End Street, com	97½
do. do. do pref	113
Chicago.	
City Railway	190
North Chicago	83
Union Traction, com	8⅛
do. do. pref.	87
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	16⅞
do. pref.	59
Electric Boat, com	80
do. do. pref.	70
Electric Vehicle, com	19½
do. do. pref.	25½
Westinghouse, com	166
do. pref.	190
General Electric	180
Boston.	
Edison Electric Illuminating	253
General Electric	180
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	158
National Carbon, com	60¾
do. do. pref.	115½
Philadelphia.	
Electric Company of America	11¼
Electric Storage Battery, com	86¾
do. do. do. pref.	86¼
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	140
Western Telephone Company	16
New England Telephone Company	184
New York.	
American Telegraph & Cable Company	190¼
Commercial Cable Company	210¼
Mexican Telephone Company	1¼
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	94⅛
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Chicago Subway	82½
Otis Elevator Company	60
Standard Underground Cable	..
Twin City Rapid Transit	116½

NORTON SWITCHBOARD INSTRUMENTS.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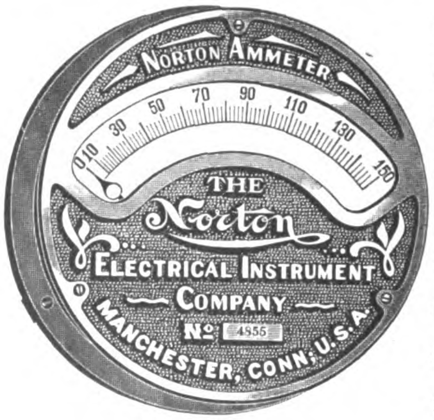
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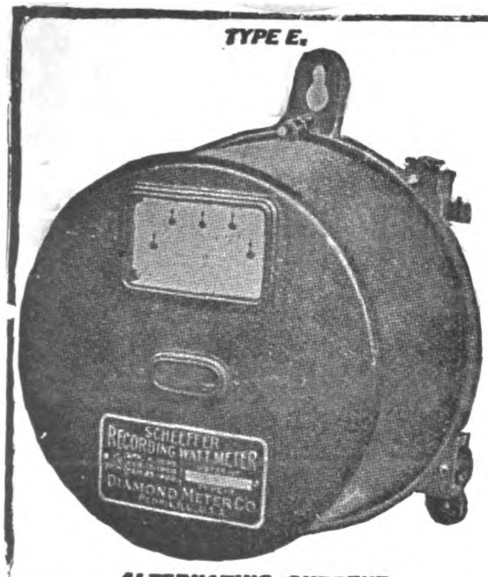
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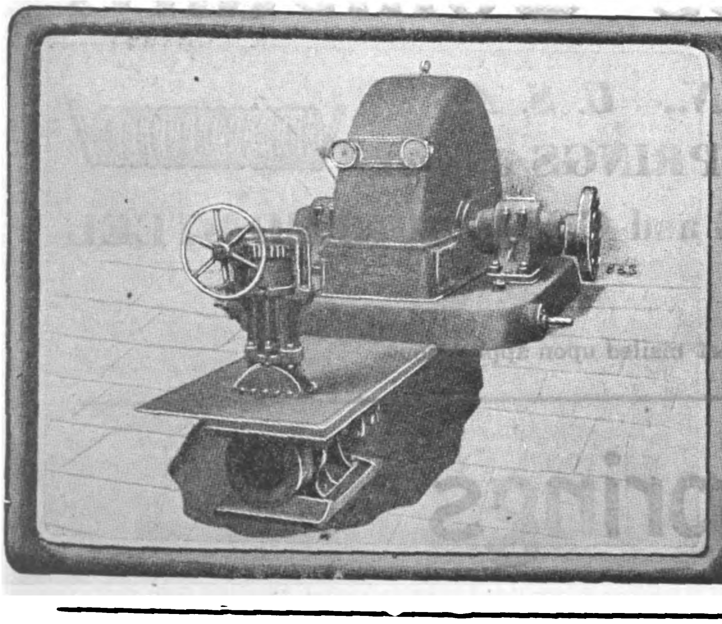

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EDITORIAL NOTES.

The Girdle Around the Earth.

Before President McKinley's death his expressed and reiterated desire was to see the Orient and the United States united by a trans-Pacific cable. But the hurried course of events, resulting finally in his tragic death, left the matter in abeyance. In fact, the developing crisis between the empires of Japan and Russia, acted as a retarding influence to any form of external enterprise and the question of the unification of the East and the West was delayed until a more propitious occasion.

The president of the Commercial Cable Company, however, recently sent word to the press of America that the necessary diplomatic steps had been taken with such success that the construction of this connecting link was an assured fact. Through the influence of Mr. Takahira, the Japanese Minister to the United States, the signature of Japan was secured to an agreement with the cable company giving it landing right in Yokohama. This, in conjunction with similar landing rights in Shanghai secured from the Chinese Government, means the accomplishment of one of the most gigantic enterprises hitherto attempted. As Mr. Clarence Mackay states, "We will pierce the Far East at three points, the Philippines, China and Japan. With the cable just completed to Newfoundland, plus a fifth cable to Europe to be laid this month, and the cable from Guam to Japan and from Manila to Shanghai, the company will have a system extending nearly around the globe." So far, in spite of a common belief to the contrary, the Pacific Ocean has not been bridged, and the transmission of dispatches was by a round-about way from Oriental centers. Telegraphy has covered the earth with its network, and this, in conjunction with the cables already in use, constituted the connecting links between London, New York, Paris, Berlin, and the far distant lands of Africa and the Orient.

A great sense of obligation should rise in the heart of the thinking man in coming to a full realization of the value and importance of these epoch-making moves. Geographical boundaries may change through rapine and warfare, and even political cataclysms change the internal governing forces to an unrecognizable extent, yet the commercial expansion, industrial and financial development of any great center of civilization, is under the absolute sway of the cable reports.

In this respect the cable is the regulator of the world's affairs. It is the means by which news, quotations and messages are flashed from metropolis to metropolis. The establishment of a complete girdle of cables around the globe would give a greater impetus to progress than can be adequately described. Electrical difficulties of a far-reaching and depressing nature have been gradually overcome. When Cyrus Field, with the assistance of Lord Kelvin, laid the first cable, it failed miserably. It lay at the bottom of the Atlantic for many long months before a companion cable took its place. Trials of this kind cost millions of dollars and required the aid of the keenest engineering minds of the day to overcome the stupendous problems involved.

Cable laying is now a matter of as much scientific assurance as cable manufacturing. The siphon recorder has displaced the mirror galvanometer with its uncontrollable and eccentric deflections.

To-day the girdling of the earth is merely a matter of investment. The time is not so far off when the laying of a cable, if successful, was regarded as the one human deed that defied competition.

* * *

Fatal Accidents.

Fatal accidents will occur in power stations in spite of everything that is said and done. Fortunately such fatalities are not of frequent occurrence in this country in spite of the large number of power houses scattered throughout the length and breadth of the land.

In England the subject of death by electric shock is receiving just now considerable attention, due to two fatal cases which recently occurred.

One of the victims was a trained electrical engineer who knew the dangers of the station and who was pointing them out to a laborer who was to make some alterations. His hand came in contact with a live part of the switchgear while his attention was taken up with conversation relating to the work.

The other victim was a workman who, it seems, was admitted to a high tension sub-station to perform certain duties without realizing the serious nature of his surroundings, a fact which after the accident brought upon the company owning the station the censure of the coroner and his jury.

Adequate precautions are necessary to protect those who are not acquainted with the dangers attending high tension working, but we know that technical men who do know the dangers too frequently disregard their existence and omit to use the special precautions provided. There is a text here for a long lecture.

* * *

The Electrical Export Trade.

Probably no other branch of industry is paying more attention to export trade than is the electrical industry. It has made wonderful strides in the last few years in the foreign trade, but there is still plenty of room for expansion. This leads us to remark that a factor in foreign trade upon which too much stress cannot easily be placed is the salesman. However excellent the product may be, and however reasonable the price, it is, after all, the seller who puts it upon the market. The traveling man is the real pioneer of trade. Well located general agencies, good advertising, willingness on the part of the manufacturer to expend money in extending his market, and an efficient consular service, are all important, but all may fail if the experienced, energetic salesman is wanting. This may be accepted as an axiom of trade which is universal in application, and of which the history of our own trade, domestic and foreign, furnishes abundant proof. For instance, in Germany, evidence is not wanting that an agency at Hamburg or Berlin, however well equipped, cannot hope to secure an important trade in other parts of the empire except through capable salesmen who thoroughly canvass the territory.

It is no reflection on foreign salesmen to say that, as a rule, American salesmen, or salesmen thoroughly familiar with American methods, probably succeed best with American goods. This is certainly true of machinery, the American salesman of which is likely to have had an apprenticeship in the factory or to have special knowledge of machinery. The foreign machine agent is likely to have preconceived notions of how sales should be made for a great millionare business concern, and how far it is proper for a merchant to get around a dynamo with a monkey wrench or an oil can. In fertility of resource to avoid delays in forwarding goods, in fulfilling contracts, setting up machinery, etc., the American salesman has no superior.

The electrical manufacturer who is really in earnest in his efforts to secure foreign business should so organize his selling department abroad as to avoid delays as much as possible. Failure on his part or that of his general agent to answer correspondence or to forward goods promptly may cripple the efforts of the best salesmen. The plan adopted by some large manufacturers of meeting their salesmen in foreign fields seems to yield good results. If this cannot be done by the manufacturer himself, he can have his general agent do so and report to him.

The rapid extension of our avenues of trade into foreign lands should stimulate a large body of our young men in the learning of additional modern languages and in other preparation for a career in this branch of our trade. In no other field of endeavor is higher business talent required and in none other are the rewards more certain.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

It seems now as if the long-looked for opposition to the Bell Telephone monopoly in New York is a reality. It will be seen in our news columns that a giant Independent Company, with $50,000,000 capital, filed articles on Saturday at Albany, and we are informed that the influential backers of the new company are ready for a great battle with the Bell.

The Illinois State Electric Association will hold its annual meeting at Peoria, October 5 and 6, with headquarters at the National Hotel.

The general commission on municipal ownership and co-operation of public utilities appointed by the National Civic Federation will be made at a meeting called for October 5 at Columbia University, New York City. It is proposed then to appoint a sub-committee of nine to be sent to Europe for four months to investigate the results of municipal ownership abroad. A similar committee will make inquiries in this country.

Prof. Herbert S. Evans of the University of Nebraska has been appointed professor of electrical engineering in the University of Colorado at Boulder.

A scheme is on hand to make Pittsburg, Pa., smokeless. The object is to create a central power plant in Washington County, about 30 miles from that city, and to supply power for the many towns in Western Pennsylvania and Eastern Ohio. The power is to be transmitted through pipes and by electric cables to the cities. A meeting is to be held in a few weeks and a company organized with sufficient capital to start the contracts. It is claimed that it will only require one year to erect the buildings and start the plant.

Consul Ernest L. Harris of Chemnitz reports that it is contemplated by the German Government to use wireless telegraphy to prevent accidents. He writes: "Recent disastrous railway accidents in Germany will probably lead to the general introduction and use of wireless telegraphy on all the State railways. Two years ago exhaustive practical experiments were commenced and continued until recently on the military railway leading from Berlin to Zossen. The telegraph stations on the route were each fitted up with a transmitter and receiver, while the trains were equipped with the same apparatus. The ordinary telegraph wires along the track were also used to facilitate the work. The experiments proved conclusively that the different stations could at any time communicate with a train running at full speed and warn it of impending danger."

LIGHT, HEAT AND POWER PRINCIPLES.—I.

BY NEWTON HARRISON, E. E.

Introduction.—The field of engineering has broadened sufficiently to include more than the term itself implies. Engineering, as now construed, is not limited entirely to the consideration of those problems hitherto regarded as belonging entirely to its peculiar domain. On the contrary, it embraces the most important problems of the hour, as far as material comforts are concerned. It enters into the field of illumination, with the purpose of pointing out, as well as crystallizing, the principles upon which that which is called illumination and wiring are based. It enters into the field of heating and cooking; regarding these domestic propositions as part of the scheme as now outlined. Hygienically, it offers to be the means by which not only sight is preserved by the development of a bright and uniform light in all homes and public places, but it offers to supply, by the use of electricity, means by which the temperature of buildings, whatever their purpose may be, is sustained without the use of steam or heated air. As a source of light, electricity is a non-oxygen consuming form of illumination, and as such is justifiably the superior of any other source of light suggested or utilized. As a source of heat it withdraws nothing from the surrounding atmosphere, leaving it as before with its full quota of oxygen gas. In these two respects, the applications of electricity have such pronounced advantages that the only situation, left to consider, is that relating to the cost of production in either case. In that of light, the public estimation of its value for street and private lighting leaves little to be said. As regards its use for heating, the question of cost appears as the only element requiring a better solution. Although generally regarded as the only and ultimate means of light and heat in the future—electricity is not entirely within the scope of the general public as an ordinary commodity. When its introduction begins in the average home, then lighting will fill its expected niche in the category of household wants. Both light and heat as produced by electricity represent distinct departments of electrical engineering requiring separate treatment and consideration. They, in common with power produced by the same means, are broad enough in their scope, to cover a field of such great dimensions, that with the exception of the principles and methods employed in the transmission of intelligence; or isolated instances of the application of electricity in medical treatment or research; electrical engineering as thus defined enters into the operation of city and suburban life more than any other force to which reference could be made.

Conditions of Electric Lighting.—Without a demand for an electric light equipment no community can feel justified in encouraging the erection of such a plant. The conditions of electric lighting are those which primarily arise through the necessity for a better form of illumination, more than through the fact, that either a power or fuel source is conveniently near, or an enterprise of some sort is required to give that touch to town or city life best secured through the use of electricity for lighting. Yet whether these circumstances appear or not, the conditions of electric lighting are those which enter into a consideration of the following:

1. Whether the community to be supplied with a plant is compact and represented by stores and private dwellings as well as needing light in its principal thoroughfares.

2. Whether the community to be supplied with a plant is of a scattered nature though represented by stores and private dwellings as well as needing light in its principal thoroughfares.

5. Whether the character of the community is sufficiently permanent to lead to the conclusion that further extensions of the system will be imperative to meet the demand for light.

4. Whether the growth of the community is sufficiently independent of large factories, to possess the inherent power of expansion, without regard to the success of said factories or not.

5. Whether the community is large enough in size to require more than one center of distribution in the lighting scheme, such as sub-stations, etc.

6. Whether a single station will be sufficient to supply all requirements when the expected contracts for light are closed with the municipality, and the private consumers desiring electricity.

7. Whether water power or coal will be utilized for the purpose of operating the plant, or both; in which case the temperature variations during the year will have to be taken into account to determine during what part of the year the water will be serviceable as a source of power.

8. Whether a contract can be closed with the village, town or city, for public lighting, to partly guarantee the success of the project.

9. Whether the transportation of machinery is within the scope of the facilities afforded, or whether heavy additional expense for machinery would have to be added through inadequate railroad connections.

10. Whether skilled help can be secured with ease or with that difficulty which would add unduly to the running expenses of the plant.

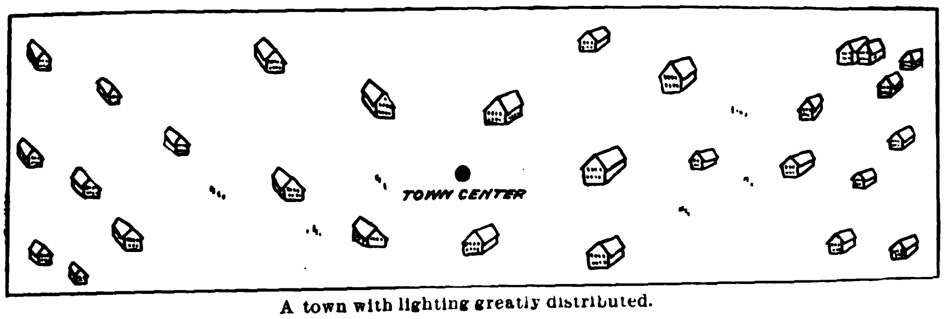
Along these lines, the conditions of electric lighting may receive the attention necessary to secure an intelligent appreciation of all requirements. Other items, in addition to these enumerated, may be added, as fresh circumstances arise, when the final consideration of essential details will bring them to view. But although it is customary to regard this particular department of applied electricity as a purely technical proposition, it is clearly evident that as a technical business proposition it emphatically holds first place. Instances of where gas lighting plants were installed, long before the electric light plant, have given rise to the question whether such competition, when keen, can lead to any form of success in a contracted community.

In other words, the best conditions for the healthy developmont of the electric light industry, are those which first mean a popular demand for illumination of this character; second, the possibility of expansion on the part of the town; and third, a price for water power or fuel, which permits a reasonable profit in its transformation from mechanical to electrical energy.

Character of the Current Employed.—The expense of installing an electric light plant, is only a part of the total expense invited by the enterprise. The erection of pole lines or the interment of the conductors underground is well recognized as a feature of the construction which is as necessary, as it is subsequently costly, to keep in repair. In this respect the setting of the poles, the choice of the insulators, and the size of the copper conductors, are bound to have a future effect upon the operation of the plant.

On the other hand, the town may be several miles in length with its business center, important streets or avenues, and suburban homes stretching along over a considerable distance. A long pole line would thus become a necessity for the distribution of the current to the various points of tap. If the town is grouped around a given center the population, comparatively thick in numbers, and then thinning rapidly, the problem of choosing current becomes much simplified. The currents to be generated belong to either of two kinds as follows:

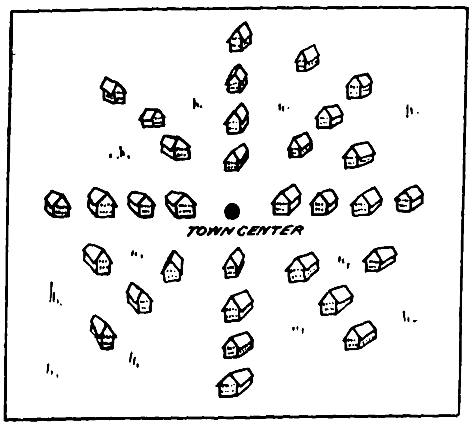
First—Alternating current of high pressure, used in conjunction with transformers, for converting it to a lower pressure whenever necessary.



A town with lighting greatly distributed.

Second—Direct or continuous current of comparatively low pressure, for use just as generated in stores, streets or homes along the line or within easy access of it.

The use of alternating and direct current in small communities is governed by the geographical position of it as already stated. The cost of an alternating and direct current plant, for equal amounts of lighting displays this feature: That under propitious circumstances, it is better to use direct than single phase alternating current, for the reason that motors cannot be readily run by the latter except when specially constructed. Whereas the direct is in some respects, an advantage, it is also a more expensive form of energy to conduct; because if transmitted at a high pressure, it is not readily transformed down; and for equal powers in comparison with the alternating current, takes very much more copper.



A town with lighting concentrated.

But the proposition which practice has laid down is this, that when the towns are distributed over a large area, the alternating is by far the best current to employ. On the other hand, if a particular case presents itself, of a village or town closely grouped— then the cost of a direct current plant, with its convenience would become readily apparent, if the use of power for small motors is considered. The conclusions reached are therefore as follows:

First—A straggling town covering considerable area and distance is a case where alternating current is the only form of electricity to employ.

Second—A small, compactly settled town is a case where the use of direct current is worthy of first consideration.

Comparison of the Circuits for Equal Power.—The only means of comparing the sizes of copper wire required, in the case of a given amount of electrical energy transmitted, as high pressure alternating, or low pressure direct, is by estimating the relative cross-sections of copper required for equal lengths of circuit. Taking a given case of 100 kilowatts of power, transmitted as alternating current a distance of one-half mile, at a pressure of 2,000 volts, the total watts would equal 100 × 1,000 = 100,000. At 2,000 volts pressure the amperes would be equal to 100,000 ÷ 2,000 = 50, without paying any attention to the losses experienced through inductive efforts, etc. At present the size of wire required with a single phase system would be, with an allowance of 10 per cent. drop in the line, not much less than

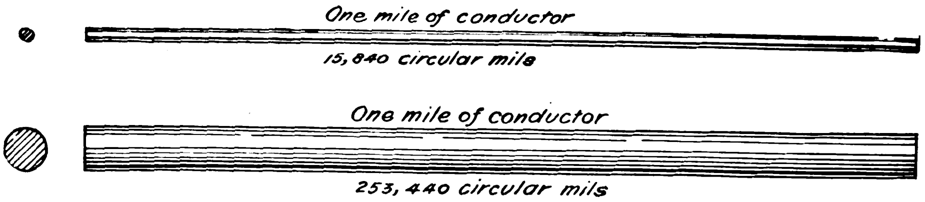
$$\text{C. M.} = \frac{\text{Length of line in ft.} \times \text{amperes} \times 12}{\text{volts drop}}$$

$$= \frac{5{,}280 \times 50 \times 12}{200} = 15{,}840 \text{ cir. mils,}$$

or about a No. 8 wire B. & S. gauge. On the other hand, if the same method and the same line conditions are supplied in the case of the direct current sytem, the figures present themselves as follows with a 10 per cent. drop and a pressure of 500 volts. C. M. = circular mils. Amperes = 100,000 watts ÷ 500 = 200.

$$\text{C. M.} = \frac{5{,}280 \times 200 \times 12}{50} = 253{,}440,$$

or a wire which could only be strung as a stranded cable, as its size would be more than No. 0000 B. & S. gauge, or about 24 No. 10 wires in circular mils. Comparing this cross-section of copper with that of the first, means 253,440 ÷ 15,840 = 16 times. This result shows, that for a half mile run it is not practical to use 16 times as much copper is one case than another. As two conductors are employed in each circuit, the total weight of copper would be really that of one mile of each of the given sizes.



Comparison of the two sizes of conductors carrying equal power.

Pressures of Standard Generators.—The outside demand has largely contributed to the adoption of certain standard pressures. These run as follows with direct and alternating currrent generators:

Direct Current. Generators of	Alternating Current. Generators of
125 volts.	2,200 volts.
250 volts.	6,000 volts.
550 volts.	10,000 volts.
600 volts.	15,000 volts.
1,000 volts.	20,000 volts.
2,000 volts.	30,000 volts.
2,500 volts.	40,000 volts.
3,000 volts.	60,000 volts.

In the table the last four quotations of 1,000, 2,000, 2,500 and 3,000, the direct current machine for high tension arc lighting is kept in view. The last figures, showing the difference in sizes of conductors, for 500 direct and 2,000 volts alternating would necessarily become the same if a high tension direct current were introduced. But although this system would serve and be less expensive than the alternating for street lighting, it could not be employed for hall or residential lighting on account of the great danger involved.

Capacity of machines.—The use of either alternating or direct current generators calls for a knowledge of what is to be expected of them, when under heavier strain than usual. The overload factor, in other words, is a point of first importance in their purchase. According to the recommendations of the American Institute of Electrical Engineers, in its Standardization Report, the ability of a generator to be overloaded 25 per cent., without its windings rising in temperature more than 27 degs. Fahr. over the normal temperature of full load, or 50 per cent. for a short period of time without destructive sparking, is a sign of the value of the generator to meet the conditions of service. The questions relating to the best conditions under which electric lighting can be begun are not more important than those which relate to the qualifications of a machine to perform its functions in this field of engineering.

ELECTRICAL POINTERS.

BY W. H. WAKEMAN.

The night engineer of a certain mill was preparing to start the small independent engine which runs the dynamo for incandescent lighting. Having used a kerosene oil lantern on some other work and wishing to hang it where it would afford sufficient light for oiling and starting the small engine, he hung it on one of the electric switches close by.

Proceeding to start the dynamo he raised the voltage to its normal place and threw in the main switch. As the metal handle of the lantern was on the positive and negative parts of an auxiliary switch it made a short circuit without delay. (See Fig. 1.) Lively fireworks were in evidence for a few seconds but no special harm was done. The engineer has another place to hang his lantern now, where the handle does not imbed itself into the hook which supports it.

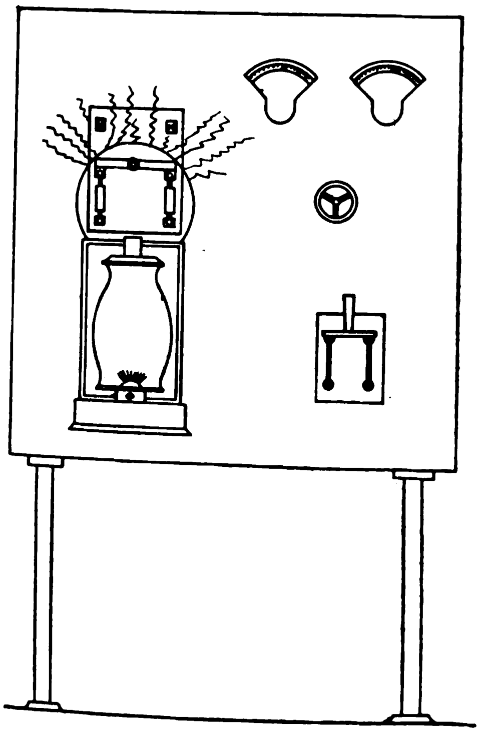


FIG. 1.

On another occasion when an attempt was made to start the aforementioned dynamo it failed to generate current. The fault was finally located at 2, Fig. 2, where a loosely made connection failed to answer the purpose. It is not readily discovered because the wire was practically out of sight more than appears in the illustration, for the frame was made in what might be called a hollow or concave form, and this wire was close to the highest part of the under side of it. The tape with which it was thickly covered helped to conceal the fault.

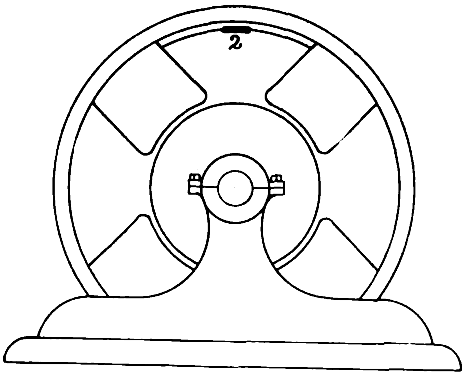


FIG. 2.

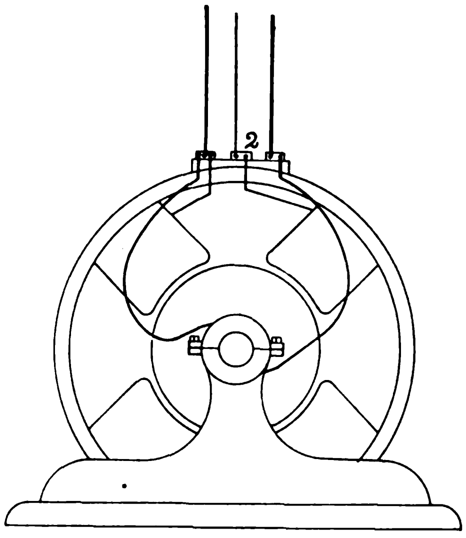


FIG. 3.

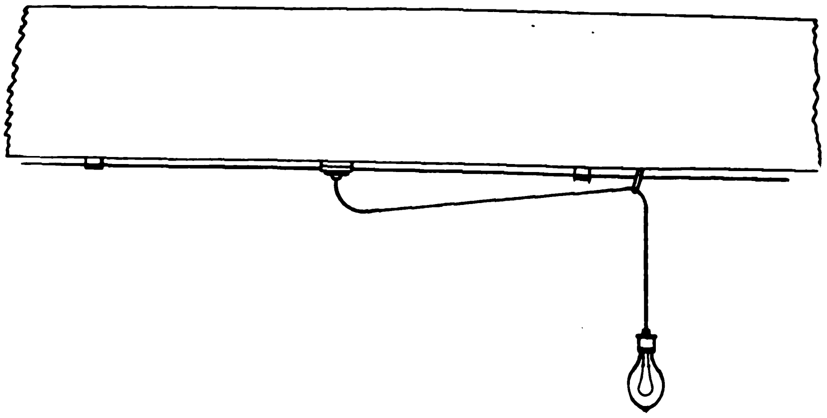


FIG. 6.

Another dynamo, illustrated in Fig. 3, failed to generate, although it was in good order a short time before. The first examination of the connections failed to disclose a defect, as all wires were in place, but when they were pulled to see if all connections were screwed down tight, the field coil connection under 2 was found broken. As the insulating covering still remained in place it appeared to be all right, but it was not until the broken piece was removed, the end cleaned for about 1 inch and inserted under the screws which were tightened, causing the trouble to disappear.

When doing such work it is always a good idea to shut off the current even if not more than 110 volts potential are carried. Failures to do this on the part of a certain electrician caused his screwdriver to assume the form shown in Fig. 4.

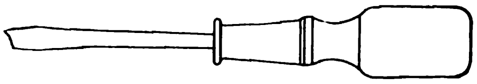


FIG. 4.

As a piece of hardened steel is not melted without a considerable heat, a large flash was in evidence but no further harm was done.

On another occasion the engineer of an electric power station handled one of the bus bars carrying 550 volts without harm. Why were the results so different? Probably because the engineer stood on a rubber mat and only touched one bus bar at a time. Visitors to electric plants are not advised to try a similar experiment as the result might be disastrous.

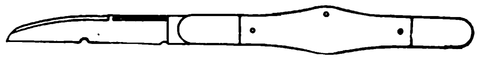


FIG. 5.

A machinist found that one of the incandescent lamps in his room was not burning to good advantage. Examination of it showed that good connections were not made between the feed wires and the socket. Taking out his knife he proceeded to scrape one of the wires to remove the insulation. When the steel touched the copper wire fire began to fly (the result is shown in Fig. 5), but no further harm was done.

When incandescent lamps are installed in our engine and boiler rooms, also in machine shops and other places, we expect that short circuits will annoy us, as vibration of buildings, running of belts, changing hangers and moving machines to other places will result in chafing of the insulation and breaking of wires as time advances.

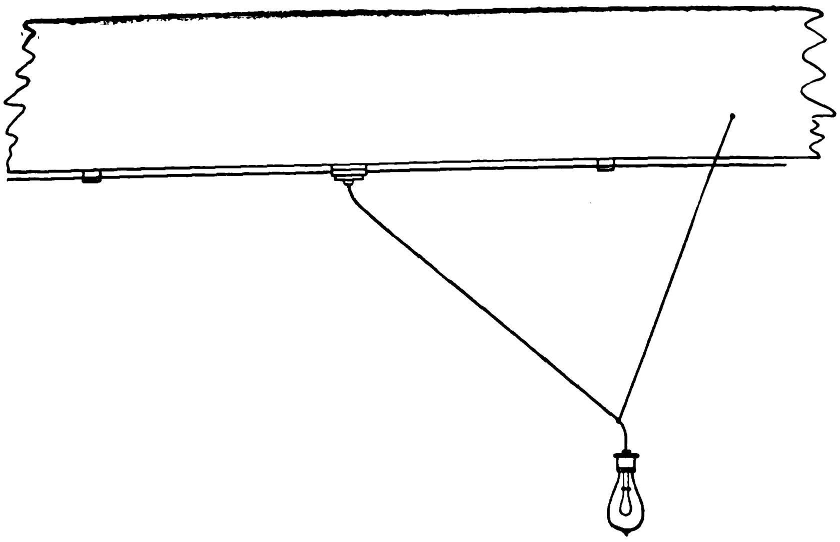


Fig. 7.

Sometimes an electrician will locate a lamp where it is not wanted, and in order to give better satisfaction the engineer or fireman may move it slightly by driving a staple into the timber overhead to support it in a new place, as shown in Fig. 6.

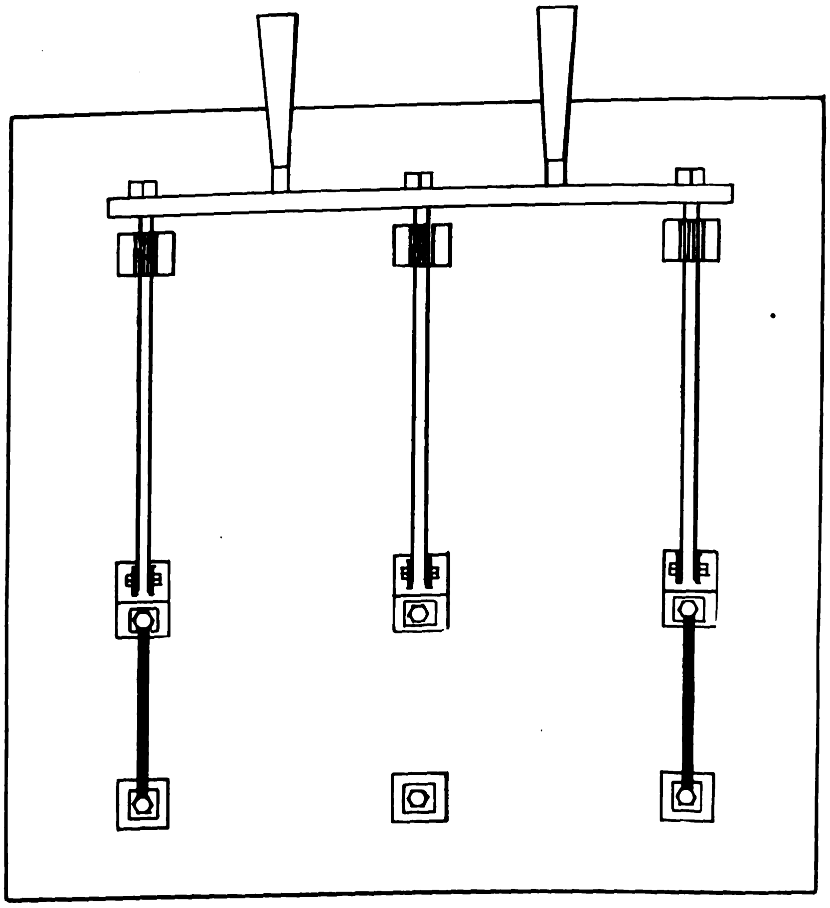


Fig. 8.

This is all right provided the staple and the wire are both wound with adhesive tape to protect the metal, although it might not meet the approval of some insurance inspectors. If the tape is omitted we should certainly expect that the iron staple and the copper wire would soon come in contact and make a "ground."

Fig. 7 shows another way of doing this by means of a stout string attached to the lamp cord. This looks harmless, but in a certain boiler room this plan has been adopted and worked well for a time until one day the ground detector on the switchboard indicated a ground connection. Investigation of the matter did not disclose the cause of trouble until this cord was removed, when the ground detector ceased to indicate a fault in the line. It is much better to take the time necessary to move the rosette to a new place.

Fig. 8 illustrates a 1,000 ampere switch on one of my switchboards. It was made for a three-wire system but two wires are enough for our use under given conditions. It is fitted with two handles, neither one of which is centrally located. If I use but one it does not throw up both sides alike, and if I use one hand on each am I not violating a very good and safe rule which says that only one hand shall be used at any one time in manipulating switches?

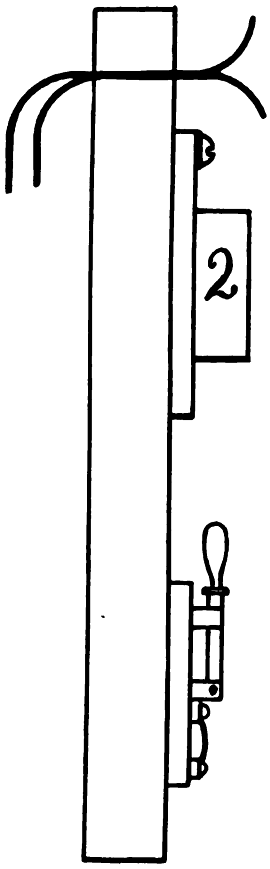


Fig. 9.

The object of this rule is to prevent an operator from getting both hands on live connections at once, thus causing a short circuit, which might be fatal. Would it not be much better to make such a switch with one large handle upon which a man could put both hands if necessary? It certainly would be safer.

Perhaps I am over-sensitive in the matter but if so there is a reason for it. Having used both hands in such a case, under conditions that were right for trouble, and experienced the sensation caused by the current used to supply 16 arc street lamps passing from one arm to the other through my body, the remembrance of it will last a long time and prevent future misdeeds along the same line.

Fig. 9 is an end view of another switchboard showing a voltmeter at 2 with the wires above it disconnected. Those pointing downward at the left are connected to the bus bars, which are not shown. Those at the right were formerly connected to the voltmeter, but are now separated from it. Their ends are wide apart so that they appear to be safe although the current is not shut off.

When the engineer thoughtlessly took hold of the left hand side and drew them through the small hole in the switchboard, the loose ends came together causing a short circuit which threw out a stream of fire more than a yard long, and narrowly missed the face of a spectator. The copper wires were burned as far back as they were uncovered, until the insulation separated them.

Nearly all such accidents are caused by acts which an engineer or an electrician knows will cause trouble, if time is taken for consideration, but it is not taken. Familiarity with the forces of nature is a very good thing provided it is not carried far enough to breed contempt, for that always works to our disadvantage.

LARGE THREE-PHASE ALTERNATORS FOR LONDON.

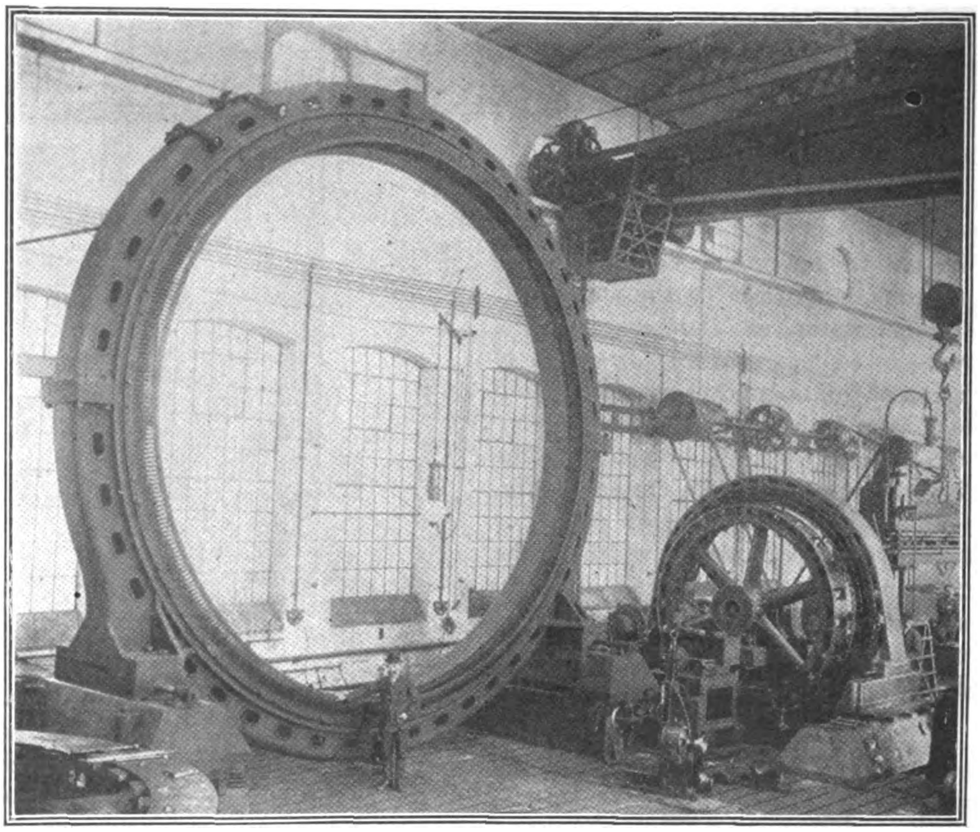
(From our London Correspondent.)

It is known that the London County Council has thus far been operating its conduit lines in the Southern District of London chiefly by means of electricity purchased from some of the electric light and power companies located there. These companies have naturally benefited greatly under this arrangement, for the demand for millions of units a year for a tramway load, notwithstanding the exceptionally low rate received, was just what two of the companies were in need of. They had been struggling with adversity for a time—indeed one of them was the celebrated Deptford undertaking, where, some 10 to 15 years ago, Mr. Ferranti's then gigantic high tension work was done, that pioneering work which led to more or less spirited controversy and ended so unhappily. From these generating stations the council took its supplies of energy to sub-stations for conversion and transformation down to the direct current line voltage.

But this arrangement will come to an end before long now, for the great power station at Greenwich—designed for 40,000 hp. capacity in 5,000 hp. generating sets—is getting near to completion, and early in the new year it is expected that the supply companies may have to find a new customer for their power.

The Greenwich station is on the bank of the Thames, so its fuel will be brought to the wharf by water, and ample condensing water is available. The boilers are of the Stirling water tube type, and a 6,600-volt three-phase alternating current is to be transmitted by underground cables to the various sub-stations as indicated above under the present agreement with the companies, for reduction by means of rotary transformers to 550 volts direct current.

Four of the three-phase generators have been made for the council by the Electric Construction Company of Wolverhampton. The armature, etc., of one of these alternators can be seen in the illustration. Each machine is designed to give a continuous output of 3,200 K.V.A. at a speed of 94 revs. per min.; the periodicity being 25 complete cycles per second per phase. The output of 3,200 K.V.A. is to be rated with a power factor of 94 per cent. The working pressure is 6,600 volts and the current per phase 280 amperes. The machines are to be equal to an overload for two hours continuously of 25 per cent. additional current, that is, 350 amperes per phase.



Large Three-phase Alternator for London Tramway Power House at Greenwich.

The field magnet system is constructed directly upon the rim of the engine flywheel, in which the amount of stored energy, when revolving at a normal speed, is 11,000 foot tons.

The alternators will be driven by Musgrave steam engines arranged for compound working, with high pressure cylinders vertical and low pressure horizontal, each set having two pairs of cylinders. The alternators are placed between the cranks. When the council's plans were made public criticism was offered because turbines were not adopted for this big station.

THE MAINTENANCE OF COMMUTATORS AND BRUSHES.*

BY S. LEES.

(*Concluded from page 161.*)

Before commencing to true up a commutator a large piece of stiff paper should be placed in the commutator pit to receive turnings, dust, etc., and the terminal blocks and any other bare current-carrying metal work kept well covered to prevent copper dust from being deposited thereon. The bearings should also be protected in order to exclude dust and grit from the oil-wells. It is a good plan to fix a piece of stiff paper over the end of the armature winding from where the connections to the commutator are made. This will effectually prevent turnings, etc., from lodging between the windings. A dab or two of shellac varnish will hold the paper covering securely in place.

A useful tool designed by the writer

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*From the "Electrical Engineer," London.

for cleaning commutators is shown in Fig. 5. It is made up of well-seasoned pine, the two parts being glued and doweled together. To use, a piece of emery cloth is placed in the hollow of the tool, one end of which is fixed in the sawkerf at a, the other end being fastened down by means of two or three drawing-pins. A small quantity of oil should be smeared along the forward edge of the emery cloth to collect copper and emery dust, as these substances have a tendency to irritate the operator's nose and eyes. The tool is held firmly to the surface of the commutator, as indicated by the arrow—i. e., against the direction of rotation of the commutator—and should occasionally be given a lateral motion.

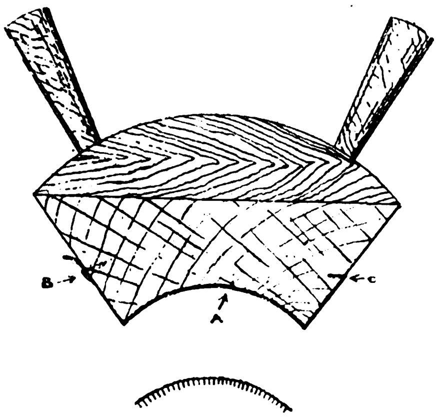


FIG. 5.

A commutator burnisher made by the Ediswan Company is illustrated in Fig. 6. In operation, a strip of emery or polishing cloth, the same width as the burner, is cut, and one end inserted under the clip at the front end; it is then turned back under the flexible backing and applied to the commutator. The flexible backing is made in such a manner that it easily adapts itself to the curve of the commutator, but it will not fall into depression on the surface. Thus the whole surface is evenly scoured with emery cloth to any degree of roughness required and afterwards polished.

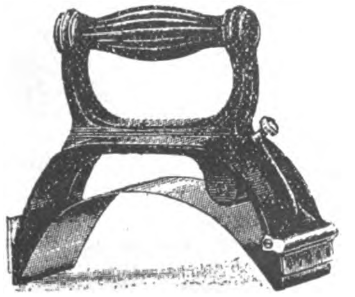


FIG. 6.

Another method of scouring commutators is to use a brick or block of carborundum. These blocks, measuring about 10 inches by 4 inches by 4 inches can be obtained in various grades from 10's to 80's. The writer was connected with a large station across the water where seldom anything else but "the brick" was put on the commutators, and, as may be imagined, quite a large number were used, as the frequent application of the brick only aggravated the formation of "flats." This method, whilst being convenient for a temporary job, is somewhat barbarous, as the commutator is only rough scoured, and when using, if the brick is not cleared of the copper cuttings, very frequently the commutator gets scored and fluted badly.

In order to reduce the wear of commutators and brushes to a minimum, the pressure on the brushes should be as light as possible consistent with sparkless commutation. This is most important where copper gauze brushes are used, as undue pressure on the brushes causes the commutator to get scorched, owing to the foot of the brush having become fused together in a more or less solid piece, thereby rendering trimming a daily operation, whereas, if properly set, and given a fair amount of attention when working, copper brushes should not require trimming oftener than once every two or three months. A brush jig is a useful tool for holding the brushes in when being trimmed. This tool may be either of wood or metal; if of the former a hard wood such as birch or teak is best, the top of the jig being slipped with a guide-piece of steel set to the angle it is desired to trim the brushes to. When using, care should be taken not to take a back stroke with the file; any stray strands of wire which may remain after filling are best removed by means of a pair of scissors or tinsmith's snips. One form of jig for holding two brushes is shown in Fig. 7.

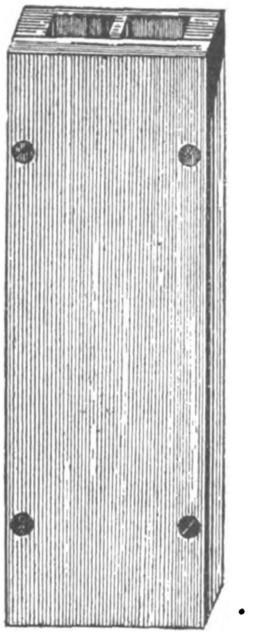


FIG. 7

Carbon brushes, which are now very extensively used, being hard and unyielding—unlike copper, gauze or wire—require bedding very truly to the curvature of the commutator in order to get sparkless running. If not bedded properly, when working, the face of the brush gets red-hot, and, finally, the brush crumbles away altogether. The best way to bed carbon brushes is to slip a piece of medium, say 1's, glass cloth or paper (cloth is preferable) between the brushes and the commutator with, of course, the business side of the glass cloth towards the brushes, and work it forwards and backwards until the brushes are bedded accurately to the curvature of the commutator. The glass cloth should be kept quite close to the face of the commutator during the operation, otherwise, if allowed to chatter or kink the brush gets chamfered down at the heel and toe, thus reducing the effective collecting area of the brush. These remarks apply equally well to carbon brushes of both the block and slab types, though the latter are not now much used owing to their fragility under working conditions. The best qualities of carbon brushes have a fine close grain, wear slowly and uniformly, and present a very soft frictional surface. Carbon brushes are usually plated with copper or nickel on the parts which come into contact with the brush-holder, and care should be taken that the plating is never allowed to come in contact with the commutator, the plating being stripped off as the brush wears away. For a good quality of carbon brush the current density to be used may be taken at about 30 to 50 amperes per square inch of sectional area, this varying with different types of machines and conditions of working.

An improved type of metal brush, which possesses many advantages over the ordinary gauze or bunched wire type, consists of a number of very thin laminations of an anti-friction metal having a higher electrical resistance than that of copper. The laminations are sandwiched between copper plates, and the whole held firmly together by means of two spring cheeks for about three-quarters of their length, the remainder of the brush being left free to allow of greater flexibility. Owing to the peculiar construction of this brush, each armature coil when passing under the brush is cut in and cut out through resistance, thus tending to reduce sparking. Another patent brush consists of sheets of anti-friction metal rolled to about the thickness of tissue paper, folded and formed under pressure to the size of the brush-holders.

The metal of which these brushes are made has copper for its basis, and being very ductile, it possesses all the advantages of an anti-friction metal and is not affected by rubbing. With this type of brush practically no trimming is required, the corners being simply rounded off, and the brush allowed to form its own bedding. It is essential to their good working that the commutator be perfectly true, and no lubricant of any kind whatever used on the commutator.

A great diversity of opinion exists among engineers as to whether anything of the nature of a lubricant should be used on commutators. Carbon brushes, if kept dry when running, have a tendency to produce a somewhat disagreeable screeching noise. The slightest trace of oil will usually stop this for a time, but the use of oil cannot be recommended, as, unless it is applied very sparingly, the oil carbonizes and causes "flashing." Pads of oil, soaked rag, or waste are messy things to use, and are apt to cause trouble if left about open parts of running machinery. A substance which the writer has used for many years with success on machines fitted with carbon brushes is refined paraffin wax. For convenience in handling, the wax may be moulded in the form of round sticks. If rubbed lightly on the commutator occasionally, the wax should soon produce a good skin on the surface of the commutator. Sometimes carbon brushes may be improved by immersion for a few hours in melted paraffin wax. To keep copper brushes in good condition the foot of the brush should always be quite clean and flexible, and never allowed to get splayed out. A mixture used by the writer with excellent results on commutators with copper brushes is made up of the following ingredients: paraffin oil, five parts; olive oil, three parts; ammonia (spirits of hartshorn), two parts.

As mentioned before, the brushes should bear on the surface of the commutator with the least pressure consistent with sparkless commutation. The best pressure to use varies greatly with the many different types of brushholders and brushes, and may be anything from a few ounces to as much as 6 lbs. or 8 lbs. Copper gauze brushes, if kept in good order, require about one-tenth of the pressure of that of carbon brushes. With the box or floating type of brushholder the pressure on the brush is greater than in those of the hinged or swinging-arm type. In the former the brushes, being usually a good fit to prevent chattering, are apt to stick if dirt or grease is allowed to accumulate between the brush and box sides, hence it is well to see that the boxes be kept quite clean and smooth.

A weak point in nearly all types of brush-holders, and one which gives much trouble at times, is the bondings. The bonds frequently get broken owing to the vibration which they are subject to when working, the break occurring usually close to the point of connection,

TABLE A.—PARTICULARS OF BRUSH-HOLDERS AND BRUSHES.

Size of machine.			Brush-holder.	Brushes.					Remarks.
No.	Kw.	Vol s.		Quality.	Actual wearing length.	Pressure on brush.	Type.	Wear.	
1	3	220	Swinging arm type.	B	1 inch.	1½ lbs.	Fixed block or wedge type.	Average life = 200 running hours.	Commutator blackened frequently, necessitating regular cleaning. After three months' service, commutator worn out of true nearly ⅛ inch.
2	7	540	Swinging arm type.	A	1 inch.	1½ lbs.	Fixed block or wedge type.	After 5,000 running hours, wear = ⅜ in.	Commutator, after nearly two years' service, in excellent condition. No cleaning required.
3	20	440	Swinging arm type.	B	1 inch.	1½ lbs.	Fixed block or wedge type.	Average life = 200 running hours.	Commutator trued up after 1,200 running hours.
4	20	440	Swinging arm type.	A	1 inch.	1½ lbs.	Fixed block or wedge type.	After 5,000 running hours, wear = ¼ in.	Commutator, after nearly two years' service, in excellent condition; cleaned occasionally.
5	100	550	Fixed box type.	C	1½ inch.	5 lbs.	Floating or box type.	Average life = 1,500 running hours.	Brushes trimmed—i. e., bedded—on an average about once every 100 hours' run. Commutator trued up after 3,000 running hours.
6	100	550	Fixed box type.	D	1½ inch.	5 lbs.	Floating or box type.	After 2,000 running hours, wear = $\frac{5}{16}$ in.	Commutator in excellent condition, no cleaning required. Since the initial bedding the brushes have not been trimmed in any way, the brush faces being in perfect condition.
7	100	550	Fixed box type.	E	1½ inch.	5 lbs.	Floating or box type.	After 200 running hours, wear = $\frac{1}{32}$ in. (about).	Brushes very hard and brittle. Commutator after a short time became blackened, and scorched badly, necessitating truing up.

particularly if the bonds have sweated connections. Many types of brush-holders depend almost entirely on the bonds for their efficient working. The writer has known of cases where defective bonds have been the cause of brushes and holders getting red hot. It is essential to the good working of any type of brush and holder that a continuous metallic path be provided for the passage of the current from the brush to the brush spindle or terminal, as moving joints cannot be depended upon; even if a close fit when new they sooner or later give trouble owing to the increased resistance which is set up at the joints as they become worn. Another weak point in nearly all holders of the hinged or swinging-arm type is that no provision is made for preventing the metal part of the holder from rubbing on the commutator when the brushes have been allowed to wear down too far. In the fixed box type this cannot occur owing to the brush-holder being rigidly fixed, the brush only being movable.

The writer has recently made a series of tests on various types and qualities of carbon brushes. The tests were carried out under everyday working conditions on machines ranging in size from 3 kw. to 100 kw. The results are shown in tabulated form in Table A. Type D is made by an American firm, the brushes being obtainable through a well-known English selling-house. Type A is manufactured in France, the firm having a direct agency in London. The writer concludes from the foregoing that it pays in the long run to use a good quality of carbon brush, even though at first sight the prices may be rather high when compared with those of the poorer qualities. In the table, the brushes of machines (1), (2), (3) and (4) are all of the same size, quality A being the highest priced, B quality being about 40 per cent. cheaper. Machines (5), (6) and (7) have brushes all of the same size, D quality being the highest priced, qualities C and E being, respectively, 30 per cent. and 40 per cent. cheaper. With some qualities of mica, particularly those of the "made-up" variety, the small particles of carbon and copper produced by wear become so firmly embedded in the mica that sometimes nothing short of turning or grinding up of the commutator will remove them.

Telegraphone Show.

There was exhibited in Boston last Friday, for the first time in America, the new telegraphone, invented by Vlademar Poulsen, of Denmark, who brought it to this country. The apparatus was shown to the scientists of Harvard. It is so compact and simple that it is contained in a small mahogany box.

CENTRAL ELECTRIC LIGHT AND POWER STATIONS.

The Bureau of the Census has just published a report on central electric light and power stations for the year ending June 30, 1902, prepared under the supervision of Mr. W. M. Steuart, chief statistician for manufactures. It is the third of a series of reports on the operation and utilization of electric current. In addition to the text, which was prepared by Mr. T. Commerford Martin, of New York City, expert special agent, there are elaborate tables and an interesting series of illustrations.

Electric lighting dates back only to the beginning of the last century, while the history of central stations proper belongs only to the second half or, more strictly speaking, to the last quarter of the century.

In the last quarter of a century a total of over 250,000,000 lamps has been produced, or not less than 10,000,000 a year.

For convenience in study the various electric stations have been divided into two grand classes: First, those operated by individuals or corporations, and second, those operated under municipal control. Each of these classes is subdivided into, first, those doing a purely electric business, and second, those operated in connection with other industries. The latter are designated composite stations.

The growth of this industry is shown by the following figures: From 8 stations beginning operation in 1881 the number rose to 100 in 1886, to 208 in 1889, and to 247 in 1892. During the following years of depression the number of new stations fell; but in 1895, though a time of financial stringency, it again rose to 239. In 1898 it reached 277, or more than the number beginning operation in the entire period from 1881 to 1886, inclusive. The number for 1901 was 250, and for five months of 1902 it was 146. In the 20 years from 1881 to 1901, inclusive, an average of 165 private and municipal stations have begun operation each year. The spread of the agitation for municipal ownership of public service enterprises is illustrated in a somewhat striking manner. Of the 815 municipal stations enumerated, only 68 had been installed up to 1889. In that year 40 were introduced, and in 1895 the number of new stations reached 73, increasing in 1898 to 82. The returns for 1902 indicate that the ratio was fully maintained in the census year.

In 1902 there was in the United States 3,620 central electric stations, with a cost of construction and equipment of $504,740,352 Employed were 6,996 salaried officials and clerks with salaries amounting to $5,663,580; and 23,300 wage-earners with wages amounting to $14,983,112. The gross income was $85,700,605, comprising $84,186,605 from sale of current and $1,514,000 from other sources. Total expenses were $68,081,375. The total output of stations for the year, in kilowatt hours, was 2,507,051,115. The number of arc lamps was 385,698 and of incandescent lamps 18,194,044.

There has been a striking change in the character of service is these stations. In the earlier days of the industry nearly all the stations were installed for the purpose of furnishing current for arc lighting, while to-day the bulk of current is supplied for incandescent lighting, motor power, and miscellaneous service. This last includes charging telephone exchanges, batteries for boats and automobiles; pumping; hot water, steam and electric heating; electric current; and nickel plating and electroplating.

Private stations form by far the largest portion of the industry, constituting 77.5 per cent. of the total number of stations in operation during 1902. Their income from sale of current was $78,735,500, or 91.9 per cent. of gross income, the expenses of operation 92.3 per cent. of the total, while they gave employment to 89.4 per cent of the total number of wage-earners engaged in the industry and paid 90.5 per cent. of the total amount of annual wages. The primary power plant equipment of these stations formed 91.3 per cent. of the total horse power of all stations while their generating equipment formed 90.6 per cent. of the total horse power of all dynamos. The kilowatt hour output of private stations formed 92.2 per cent. of the total, and the arc lamps in such stations formed 86 8 per cent. of the total number wired for operation.

The comparison of the income of the two classes of stations is not a fair indication of their earning capacity, because of the gross income reported for municipal stations. Of this gross income, $6,836,856 resulted from the sale of current and included income from public service which was necessarily largely, if not wholly, a matter of estimation.

The private stations employed 20,863 wage earners, who were paid $13,560,771, and 6,046 salaried officials and clerks with salaries amounting to $5,206,199; while the municipal stations employed 2,467 wage earners, who were paid wages amounting to $1,422,341, and 950 salaried officials and clerks, who were paid $457,381.

The cost of construction and equipment of the municipal stations was only 4.4 per cent.; their income from sale of current, 8.1 per cent.; their expenses, 7.7 per cent., and the horse power capacity of their power and generating plants, 8.7 and 9.4 per cent. respectively. The output of such stations was 7.8 per cent. of the total kilowatt hours produced by all the stations, while their arc lamps were 13.2 per cent. and their incandescent lamps 8.7 per cent. of all the lamps reported for the country.

In addition to controlling practically the entire industry, the average private station is much larger than the average municipal station. Considering the total of 2,805 private stations, it appears that the average total expense per year per station was $22,401, as compared with $6,467 for municipal stations. The private stations gave employment on the average to 7.4 wage earners, while the municipal stations gave employment to 3. The average private stations reported 823,938 kilowatt hours per year, as compared with 240,373 for the municipal stations.

THE AMERICAN STREET RAILWAY ASSOCIATION'S ANNUAL MEETING.

This week will prove an important one for the street railway industry, as the 24th annual meeting of the American Street Railway Association begins to-day in Philadelphia at the Bellevue-Stratford Hotel and the Philadelphia Museum—the exhibit of apparatus taking place at the Museum. Following is the programme for the week:

AMERICAN STREET RAILWAY ASSOCIATION.

Wednesday, September 27, 10 A.M.—Address of welcome. Address of the president, Mr. W. Caryl Ely; approval of minutes of last annual meeting; report of the executive committee; report of the secretary-treasurer; report of standing committees; report of the reorganization committee; consideration of, and action on, new constitution and by-laws; appointment of nominating committee. Paper on "Notes on the Design of Large Gas Engines with Special Reference to Railway Work," by Mr. Arthur West; paper on "The Application of Gas Power to Electric Railway Work," by Mr. J. R. Bibbins; paper on "Single-Phase Railway System," by Mr. Chas. F. Scott; 8 P. M.—Theatre party at New Lyric Theatre.

Thursday, September 28, 10 A. M.—Unfinished business; new business; report of nominating committee; election of officers for ensuing year; 8 P. M.—Banquet at the Bellevue-Stratford Hotel.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA.

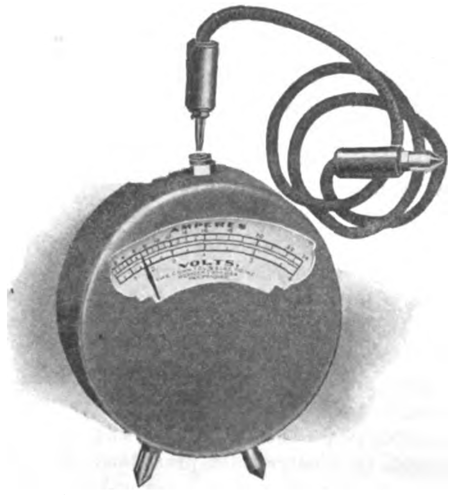
Thursday, September 28, 2 P.M.—Annual address of President W. G. Ross, Montreal, Canada; annual report of the executive committee; annual report of the secretary-treasurer; appointment of convention committee on nominations; appointment of convention committee on resolutions; report on proposed reorganization of the American Street Railway Association.

Friday, September 29, 10 A.M.—Annual report of standing committee on standard classification of accounts; report of committee on international form of report.

Saturday, September 30—10 A.M.—Unfinished business; report of convention committee on resolutions; report of convention committee on nominations; election and installation of officers.

New Connecticut Volt Ammeter.

Whenever batteries of any description are employed it is absolutely necessary that some means is at hand to test their qualities. If even one of the cells is worn out the efficiency of the others are lost, and when these cells are used to supply current for telephone transmitters, the difficulty in making one's self heard is sometimes insurmountable. The Connecticut Telephone and Electric Company, of Meriden, Conn., has placed upon the market a new type of volt ammeter which is invaluable for this purpose and which is shown in the accompanying illustration. This instrument is especially designed for testing batteries and is coming into general use everywhere. It is made up in two styles, one as a combination voltammeter and the other reading in amperes only. The scales are graduated from 0 to 30 amperes and from 0 to 6 volts, and are very carefully calibrated. The arrangement of the needle supports permits very delicate and accurate reading. This instrument can be used without the cord shown by holding it in the hands. This is an exclusive "Connecticut" feature. This instrument is guaranteed by the company to be accurate, durable and free from mechanical defects. The company will be pleased to furnish particulars to parties interested.



A NEW VOLT AMMETER.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPT. 19, 1905.

Electric Railways and Appliances.

799,704. Electric Railway Signal. Joseph Bartl, Chicago, Ill. Filed Feb. 26, 1904.

799,752. Signaling System for Railways and the Like. Claud D. McPhee, Arnprior, Canada. Filed May 5, 1905.

800,022. Train-Operated Time-Signal System for Railways. William B. Severance, Manchester, N. H. Filed May 29, 1905.

800,121. Car-Fender. Joseph W. Seibert, Washington, Pa., assignor of one-third to Elias Lewis, same place. Filed July 20, 1905.

Electric Lights and Appliances.

799,655. Dash Electric Headlight. John Kirby, Jr., Dayton, O., assignor to the United States Headlight Company, Buffalo, N. Y. Filed Dec. 10, 1904.

Electrical Machinery and Apparatus.

798,684. Electric Fuse. Henry N. Snyder and Lewis A. Hardison, Santa Paula, Cal. Filed Aug. 8, 1904.

779,720. Electromagnetic Clutch. Henry H. Cutler, Milwaukee, Wis., asssignor to the Arnold Clutch Company, same place. Filed Sept. 22, 1902.

799,790. Electromagnetic Lock for Automatic Circuit-Breakers. John D. Hilliard, Jr., Glens Falls, N. Y., assignor to the General Electric Company. Filed Nov. 17, 1902.

799,805. Power-Transmission Mechanism. Charles G. Simonds, Schenectady, N. Y., assignor to the General Electric Company. Filed April 8, 1904.

799,816. Block-Signal System. Harold E. White, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 11, 1904.

Telephones and Telephone Apparatus.

799,658. Telephone Signal Apparatus. David F. Laughlin, Clyde, Kan., assignor of one-half to Franklin H. Butler, same place. Filed June 13, 1905.

799,722. Portable Support for Telephones. Augustus G. Davis, Baltimore, Md. Filed Jan. 5, 1905.

799,760. Service Meter Apparatus for Telephone Exchanges. Charles E. Scribner, Jericho, Vt., assignor to the Western Electric Company, Chicago, Ill. Feb. 23 1904.

799,887. Party-Line Telephone System. Mary A. Breadheft, Indianapolis, Ind., executrix of Samuel Martin Gant, deceased, assignor to Sara O. Wilson. Filed Feb. 24, 1903. Renewed Feb. 16, 1905.

Miscellaneous.

799,678. Insulating Material. Dominick W. Sharkey, New York City. Filed Nov. 28, 1904.

799,726. Insulator. Ernest J. Foreman, Trinidad, Col. Filed March 16, 1905.

799,861. Electrolytic Apparatus. Guy L. Meaker, Evanston, Ill., assignor to the American Steel & Wire Company of New Jersey. Filed Feb. 1, 1905.

799,896. Electric Contact Device. Robert W. Farrington, Buffalo, N. Y. Filed Sept. 23, 1904.

800,052-053. Conduit and Angular Conduit for Electrical Wiring. Henry C. Ayres, Greenville, O., assignor to the Adjustable Fixture & Manufacturing Company, same place. Filed March 13, 1905.

800,054. Conduit for Electrical Conductors. Henry C. A res, Greenville., O., assignor to the Adjustable Fixture & Manufacturing Company, same place. Filed March 13, 1905.

900 055. Cover for Electrical Conduits. Henry C. Ayres, Greenville, O., assignor to the Adjustable Fixture & Manufacturing Company. Filed March 13, 1905.

800,084. Electric Water-Heater. William C. Dice, Seattle, Wash., assignor, by mesne assigments, to the Climax Electric Heater & Manufacturing Company, same place. Filed Dec. 6, 1904.

THE TELEPHONE WORLD.

$50,000,000 Telephone Company to Make War on the Bell.

A certificate showing increase of capital stock from $500,000 to $50,000,000 by the New York Independent Telephone Company was filed Saturday morning last in the office of the Secretary of State at Albany.

The stockholders signing the certificate, which is acknowledged in Monroe County, are Harrison C. Durand, Harry C. Sickels, William F. Dwyer, J. Henry Howe, Arthur C. Frith, George S. Bixby and George R. Fuller.

A dispatch from Pittsburg September 23 says that persons who have large interests in the Independent telephone movement state that all is now ready for a great battle, and that the certificate of an increase in the capital stock of the New York Independent Telephone Company from $500,000 to $50,000,000 filed at Albany, N. Y., was evidence of the fact.

Announcement will soon be made of the financial backing of the new $50,000,000 company, it is declared, and the list of shareholders will contain representatives of powerful financial institutions. Pittsburg's interest in the new company is a large one.

A meeting of the Independent interests has been in progress in St. Louis for several days and many questions in connection with the operating union have been under consideration.

Five-Cent 'Phones for New York.

A five-cent telephone rate is proposed for New York City by Thomas F. Ryan, who, according to a report which came from St. Louis Friday, is the backer of a telephone syndicate which proposes to combine all the cheap telephone companies in the country under one management.

P. A. B. Widener, William H. Page and the Morton Trust Company are mentioned as being interested with Mr. Ryan in the project. It is said that important plans of the concern are to be announced in a few days.

A combination of municipalities and Independent telephone companies and manufacturers has been formed in Toronto, Canada, for the purpose of fighting the Bell Telephone Company, and securing favorable legislation from both the Provincial and Federal Parliaments.

At a recent public sale in Owingsville, Ky., the Bath fiscal court's special commission sold the telephone franchise rights over every turnpike in Bath County to the companies whose lines now run over the roads. A rate of $1 per mile was made over all the roads.

It is now stated by the officers of the Columbus, O., Citizens' Telephone Company that November 1 will see the completion of the work of transferring subscribers to the automatic switchboard, and that soon after a new directory will be issued.

The Independent Telephone Company of Portland, Ore., has sold $1 000.000 worth of bonds, the money to be used in the construction of a long-distance line between Portland and British Columbia cities.

The Star Line Telephone Company of Olney, Ill., has been dissolved.

Keystone Conduits Cannot be Sold.

According to a Philadelphia paper, the ownership of the Keystone Telephone conduits, which have been the subject of so much controversy, and which were the cause of the coolness which sprung up between I. W. Durham and John M. Mack, eventually leading to a huge political quarrel, is likely to be so permanently vested in the Keystone Telephone Company, that no other corporation can possibly control them.

A special meeting of the stockholders of the Keystone Telephone Company will be held in Camden, N. J., on October 2 for the purpose of changing the articles of incorporation so as to prevent the directors of the company from selling real or personal property of the company without a vote of the stockholders.

This step is due to the policy of the new blood which has been injected into the Keystone board. Control of the conduits came so near to passing to the Philadelphia Electric Company that the present board has determined to take out of the hands of the directors authority to dispose of the company's assets, without the approval of the shareholders. This will probably fix for all time the ownership of the conduits, but it will not prevent the directors from renting some portion of the ducts to a desirable tenant and at a price which will be remunerative to the Keystone Telephone Company. The step will also tend to prevent any rival telephone company wresting away the conduits from their present owners. As this policy was known to the insiders it probably accounts for the recent strength of the Keystone shares.

After accepting a franchise for 21 years and agreeing to pay to the city of Perth Amboy, N. J., a percentage of its gross receipts, the Hudson & Middlesex Telephone Company startled the water board by its offer to build and maintain a private telephone line from the City Hall to the Runyon water station, eight miles away, for $200 a year. Nearly a mile of the line will be a cable under the Raritan River. The New York & New Jersey Company asked $275 a year for the cable under the river, and wanted the city to build its own line from the cable end to Runyon. The Hudson & Middlesex offer was accepted and a contract will be made for 20 years.

The Mutual Telephone Company has just been organized by prominent business men of Tower Hill, Ill. The latest improved switchboard has been ordered and the system will be installed at once. Already a number of farmers are arranging to attach party lines, and will have connection with the entire county. The officers of the new company are: President, E. G. Foster; vice-president, Dr. A. C. Jackson; secretary-treasurer, J. C. Pitzer; manager, L. B. Fluckey.

The Madrid, N. Y., Telephone Company has certified to the Secretary of State that the amount of its capital stock has been increased from $10,000 to $15,000, consisting of shares of $100 each. The amount of capital stock paid in is $9 900. The certificate is signed by Frederick J. Merriman and G. P. Horsford.

Reduction of Rates for the Bronx.

Reductions in telephone rates in the Bronx will take effect October 1.

The rate for a business service of 600 messages has been reduced from $54 to $48. For a resident service of 500 messages the rate will be $39 instead of $48. the former rate. Excess local messages will be charged for at five cents each, the old rate being seven cents.

A material reduction has been made in the charge for a private branch exchange service. The existing rate is the same as that charged in Manhattan. The new rate will be $150 for a switchboard, two lines to the central office, two telephones and 2,400 messages a year.

The instrument statement of the American Telephone & Telegraph Company for August shows gross output of 127.928. an increase as compared with last year of 29 636; net output 69.538. an increase of 17.806. Since December 31, 1904. the gross output has been 1.140.445, an increase of 370.141; net output, 734,534, a gain of 300,802. The total number of instruments now outstanding is 5,215,098, an increase of 1,001,849.

Aroused by the announcement of the Bell Telephone Company that it would charge what is deemed an exorbitant rate. the residents of Newtown, Pa., recently held a meeting and decided to build their own local telephone line. Edward P. Hicks was elected president and J. Herman Barnsley secretary. The company will start with $5,000 capital. One hundred and sixty shares of stock were subscribed for at the meeting.

The board of mayor and aldermen of Newton, Miss., has granted a 25 year franchise to E. E. Grassett and J. J. Mott, Jr., of Meridian, to establish and operate an Independent telephone system there. The same people are interested in several private lines that connect with towns adjacent to Newton, and they will also have connection with the Home Telephone Company at Meridian.

The Camden, N. Y., Telephone Company at a recent meeting elected the following officers: President, L. P. Havlin; vice-president, B. D. Stone; secretary, B. S. Osborne; treasurer, M. Stanley. The company is enjoying a largely increased business.

The Delaware & Atlantic Telephone Company has notified the Wenonah, N. J., borough council of its acceptance of the ordinance recently passed governing the franchise of the company in that borough. The company will give all night service and make other concessions.

The Farmington, Mo., Telephone Company was lately sold by T. P. Pigg to local capitalists for about $60 000, The system is one of the largest in Missouri outside of the large cities, having switchboards at Farmington, Flat River, Bonne Terre and Deer Run.

The Consolidated Telephone Company of Buffalo, N. Y., which controls the Frontier Telephone Company, has purchased the Elma Telephone Company of Elma, N. Y., and the Marilla Telephone Company of Marilla.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Albion, Pa.—The council is considering the question of having an electric light plant and waterworks.

Auburn, Cal.—At the last meeting of the city trustees it was decided to sell the old gasoline street lights and put arc lights in their places.

Austin, Tex.—This city is considering an appropriation of $10,000 for improving the waterworks and electric light plant. John H. Robinson, Jr., is a member of the water and light commission.

Broad Albin, N. Y.—The Broad Albin Electric Light & Power Company, capitalized at $50,000, has been formed with the following directors: W. P. Judson, H. C. Finch and Anna L. Judson.

Chapman, Kan.—This town is agitating the question of electric lights.

Clyde, N. Y.—The Clyde Gas & Electric Company has been incorporated with a capital stock of $25,000, by Thomas W. Summers, of Ithaca; George S. Sheppard and William T. Morris, of Penn Yan.

Fisher, Ill.—A franchise was granted to the Wardlow Electric Lighting Company of this village to carry on and maintain an electric light plant here.

Fort Worth, Tex.—Sam Davidson and others have applied for a franchise to construct and operate an electric light and power plant, and steam heating plant.

Hamilton, O.—The board of directors of the Hamilton Gas & Electric Light Company passed a resolution ratifying the expenditure of $250,000 in improvements on the electric light plant and the Otto Coke Works.

Hillsboro, Ill.—The Hillsboro Electric Light & Power Company has increased its capital stock from $5,000 to $50,000.

Hyattsville, Md.—At a recent meeting of the citizens steps were taken which, it is believed, will result in the establishment of an electric lighting plant in this city sufficiently large to light its streets, as well as those of the neighboring towns and villages. For further information address William P. Magruder or W S. Holton.

Jackson, Ga.—This city has voted to issue $39,000 5 per cent. waterworks and electric light bonds.

Kalamazoo, Mich.—The American Arc Lamp Company, successor to the Lea Electric Manufacturing Company at Elwood, Ind., has lately removed to this city.

L'Anse, Mich.—Plans for the new municipal electric lighting plant for this village have been completed by Liebert and MacNeil, of Calumet.

Morehead, Ky.—Cincinnati capitalists lately closed a contract with J. W. Riley, of this place, to erect a modern electric light plant here at once. The plant will cost $15,000.

Muskogee, I. T.—The Muskogee electric light and power plant was lately destroyed by fire. The loss is between $3,000 and $5,000.

New York City.—The Rooney Electric Light Company has been formed to manufacture electric lamps and appliances with a capital of $50,000. The incorporators are: John J. Rooney, Scarsdale; Francis J. Rooney and John Rooney, both of Brooklyn.

Port Dickinson, N. Y.—An electric lighting system is soon to be installed in this village.

Sand Point, Ida.—It is expected that about November 1 an electric light plant will be in operation here.

Scottburg, Ky.—This place is to have a water plant and an electric light plant in operation by December 1.

Shelbyville, Ind.—The Shelbyville Light & Power Company's plant, which has been operated by a receiver since its failure, has been purchased by C. F. Streeter of New York. The consideration was $36,000. It was given out that F. M. Knuckles, who was receiver of the plant, will continue in charge of the business.

Wampum, Pa.—The proposition to issue bonds in the sum of $13,500 for the purpose of erecting both a municipal water and electric lighting system was lately carried.

Wheaton, Minn.—At a recent meeting of the Commercial Club a committee of three business men was appointed to make the necessary arrangements for a new electric light plant for this city.

STREET RAILWAYS.

Altoona, Pa.—Application will be made September 28 for a charter for an electric railway line from this city to Patton.

Anderson. Ind.—H. C. Stilwell is in Kansas City, Mo., where he and George F. McCulloch will spend some time perfecting the plans whereby they will build an electric interurban railway 60 miles long.

Beaver Dam, Wis.—Joseph H. Larimer, president of the Indianapolis & Ohio Traction Company of Indianapolis, Ind., has been here looking over the prospects for an interurban electric line from Fond du Lac to Madison by way of Waupun and Columbus.

Cleveland, O.—This State is to have another interurban electric railroad. The company has been organized under the name of the Cleveland, Berea & Southern Railway Company. The incorporators are C. C. Downs and W. S. Mitchell.

Dallas, Tex.—A charter for the proposed electric railway between this city and Sherman will be filed within a few days.

Evansville, Ind.—The city council has granted a franchise to the Evansville & Mt. Vernon Traction Company.

Frederick, Md.—Promoters of the Washington, Frederick & Gettysburg Electric Railway Company announce their purpose to revive this project and say that the primary plan of the company, which is to build a railway between this city and Thurmont, will be carried out. A director of the road states that the survey has been completed, with the exception of a few changes which will probably be made.

Ft. Wayne, Ind.—Mr. Norford is at the head of an engineering party that is surveying a route for another electric line north from this city to Auburn.

Lawrenceburg, Ky.—An electric line may be built between this city and Tyrone.

Martin's Ferry, O.—There is a report that a new traction line will be built between this place and Canal Dover.

Princeton, Ill.—Another electric interurban line will be built here from the present western terminus.

Pomeroy, O.—Work will soon be commenced on the proposed electric line from this city to Zanesville.

Saugatuck, Mich.—An electric road connecting this city and South Haven is practically assured. Franchises have been granted in the village of Douglas and the township of Saugatuck.

Schenectady, N. Y.—Charles C. Kremer, of Schoharie, has been here in connection with the proposed Schenectady & Stamford Electric Railway. It is said the company will be incorporated in the near future.

Tishomingo, I. T.—The Washita Valley Interurban & Electric Railway Company has been incorporated here with a capital of $12,000,000. It is proposed to build an electric railway from Shreveport, La., to Anadarko, Okla., following the valleys of the Red and Washita Rivers. The road will traverse a very fine country and connect many good sized towns.

Watervliet, Mich.—At a recent meeting of the village council a franchise was granted to W. A. Baker for an electric road from this place to Paw Paw Lake.

POWER PLANTS.

Elko, Nev.—The Intermountain Power Company of this city has been incorporated with a capital stock of $1,500,000 by E. J. Raddats, C O. Ellingwood, W. J. Craig and others. The company will construct a power plant for the purpose of furnishing power for motive and lighting purposes.

Ft. Wayne, Ind.—Chief Engineer Elliott, of Cincinnati, has lately been here consulting with Manager Emmons about the plans for the power plant for this city.

BIDS WANTED.

Chicago, Ill.—Sealed proposals will be received until October 5 for furnishing and delivering in this city 55,000 incandescent electric lamps. Envelopes containing proposals to be indorsed Proposals for Incandescent Electric Lamps. M. C. Martin, Chief Quartermaster, Federal Building.

Duluth, Minn.—The Great Northern Power Company will build a distributing station, and bids will be called for the construction of same.

Washington, D. C.—The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until October 31 for furnishing Western Navy Yards with the following supplies: Schedule 159, wattmeters, electric traveling crane; schedule 160, motors and electric traveling hoists. On October 10 the Bureau will open bids for furnishing Eastern Navy Yards with the following: Schedule 147, dynamotors, insulators, testing sets, wire, rheostats and miscellaneous electrical supplies; schedule 148, armored cable; schedule 149, motors, conduit. On October 17 the Bureau will open bids for furnishing Western Navy Yards with the following: Schedule 141, conduit, cable, wire, electric fittings; schedule 142, motor, motor drive outfit, electric traveling hoist. Blank proposals can be obtained on application to the Bureau at Washington, and those for Eastern Yards can also be obtained at the Navy Pay Office in New York.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 16@16¼c.; Lake 16@16¼c.; casting, 15¾@16c.

The American Telephone and Telegraph Company has declared the regular quarterly dividend of 1½ per cent..

The Chicago Union Traction Company announces that its annual report will be made to the court, but will not be given to the stockholders or the public.

One of the disappointing features found in the recent annual report of the Philadelphia Rapid Transit Company is the small increase in the number of passengers carried.

A franchise tax of $1,000,000, levied by the State of Minnesota against the Western Union Telegraph Company, has been declared constitutional by the Minnesota Supreme Court.

The New York and Electric Commission has reserved its decision on the application of the St. Lawrence River Power Company of Massena to issue $1,500,000 twenty-year gold bonds bearing interest at 5 per cent.

The directors of the Electric Storage Battery Company have declared the usual quarterly dividends of 1½ per cent. on the common and preferred stocks, payable October 2 to stock of record September 28. The books do not close.

The American Railways Company, which controls a number of street railway companies in New Jersey, Pennsylvania, Ohio and Illinois, has issued its annual report, showing an increase of $1,058 in gross earnings and a decrease of $6,965 in the net.

The Westinghouse Electric & Manufacturing Company has declared the regular quarterly dividend of 2½ per cent. each on its preferred assenting and non-assenting stocks. payable October 10. Books close September 28 and reopen October 11.

A report from Cleveland says that the National Carbon Company has booked more than enough business to keep all its plants running day and night well into the next fiscal year. It is also added that evidence of the recently reported competition is as yet invisible.

The Newark & Hackensack River Railway Company and the Jersey City & Hackensack River Railway Company, both affiliated with the scheme to tunnel the Hudson River between New York and Jersey City, have been incorporated in New Jersey with an authorized capital of $1,000,000 each.

It is stated that one incentive for recent buying of New York Metropolitan stock was the published statement of arrangements for a connection by tunnel between the Metropolitan and the Public Service Corporation of New Jersey in connection with the incorporation of the Interstate Tunnel Company, to be financed by Metropolitan and Public Service interests.

The annual report of the Interborough Rapid Transit Company, which operates the Subway and the Manhattan Elevated lines in this city, was issued on Saturday last. According to the report a million passengers a day are carried by the Subway and elevated lines. The increase in gross earnings amounted to $2,649,685, while the net earnings gained $1,098,352. The increase in gross income amounts to $1,247,888, in net income, after deduction of fixed charges, to $494,195. Dividends paid during the year increased by $1,662,500 over those paid the year before, so that the surplus shows a decrease of $1,168,305. The passengers carried in 1904-5 increased in number 52,470,625 over those carried in 1903-4.

ELECTRICAL STOCK QUOTATIONS.

Name.	Closing price Sept. 25
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	212
Manhattan Elevated Railway	164½
Metropolitan Street Railway	124¾
Metropolitan Securities	80
Ninth Avenue	197
Third Avenue	126½
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	70⅛
Brooklyn City Railway	239
New Orleans Railway	36½
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81¾
Philadelphia Traction	101
Union Traction	61⅜
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	16
do. do. do. pref	59
West End Street, com	99¾
do. do. do pref	113
Chicago.	
City Railway	192
North Chicago	83
Union Traction, com	11½
do. do. pref.	42
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	17½
do. pref.	58
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	19½
do. do. pref.	24
Westinghouse, com	170
do. pref.	190
General Electric	181
Boston.	
Edison Electric Illuminating	253
General Electric	181
Westinghouse Electric & Mfg., com	85
do. do. do. pref.	95
Chicago.	
Chicago Edison	160
National Carbon, com	60¾
do. do. pref.	115½
Philadelphia.	
Electric Company of America	11⅛
Electric Storage Battery, com	86⅝
do. do. do. pref.	86⅝
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	140½
Western Telephone Company	16
New England Telephone Company	134
New York.	
American Telegraph & Cable Company	190½
Commercial Cable Company	210¼
Mexican Telephone Company	1½
New York & New Jersey Telephone Company	179½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93¼
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Chicago Subway	72
Otis Elevator Company	60
Standard Underground Cable	..
Twin City Rapid Transit	117½

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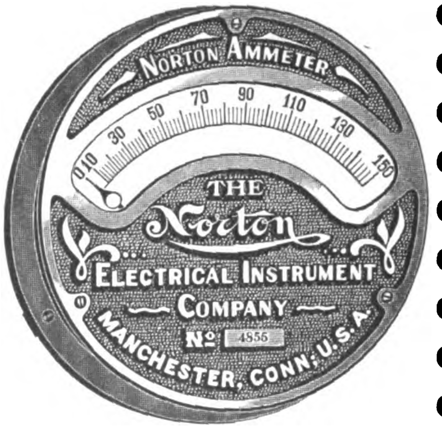
0 to 750 volts.
0 to 10 amperes.
0 to 1500 amperes.


NORTON AMMETER
10 30 50 70 90 110 130 150
THE Norton ELECTRICAL INSTRUMENT COMPANY
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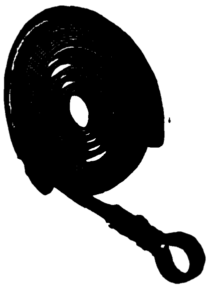

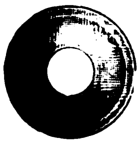

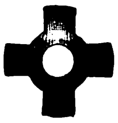

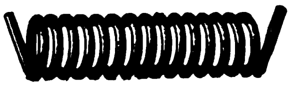

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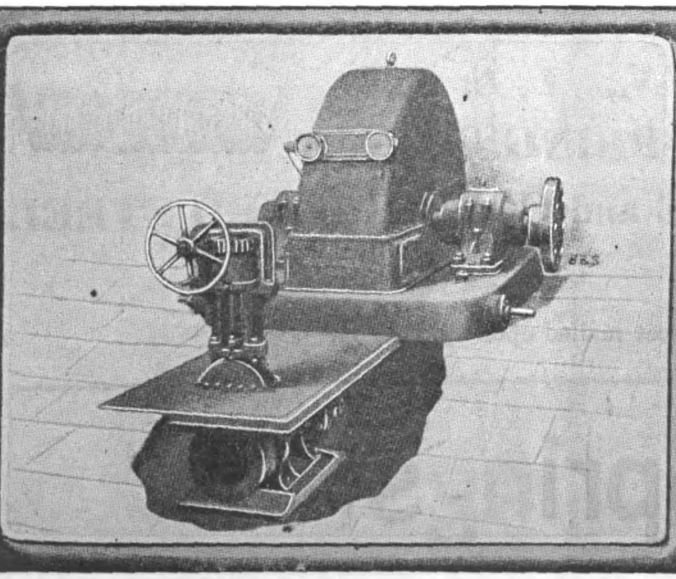

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EDITORIAL NOTES.

The Street Railway Convention.

After six days' of wise legislation in Philadelphia the various street railway associations concluded their labors on Saturday afternoon. The parent body—the American Street Railway Association—agreed upon a form of organization and adopted a new constitution and bylaws. Permanent headquarters will be established in New York City and a secretary placed in charge who understands the technical part of the business.

The convention acted wisely in re-electing Hon. W. Caryl Ely president, as it was mainly due to his untiring efforts that the new plan of organization was pushed to the front at this time.

The "American Street and Interurban Association" is the name adopted by the new organization. We welcome it to New York City.

* * *

The Torch and the Electric Lamp.

Doctor Feuerbach, head of the largest lamp works in Europe, claims that the efficiency of incandescent lamps is only 1 per cent.; 99 per cent. of the electrical energy is dissipated in the form of heat. In other words, in spite of our remarkable progress in the design and construction of power-producing machinery, our light-giving devices are sadly deficient. This deficiency arises through the peculiar, though at present necessary process the energy is passed, by which light is to be produced. It also arises through the need of employing materials that stop at the critical point in yielding up their vibrations to serve our purposes. It seems so difficult for the laity to grasp the fundamental idea underlying all of these complicated and expensive light-making methods; the idea that the light sought for is only found at one end of a color scale, while the system of getting there, now in vogue, calls for an effort beginning where the scale begins, and passing through all the intermediate stages to the end required. The power producing the light is either transformed too frequently, or it does not deliver its millions of light-making impulses effectively.

The situation therefore is one that calls for more than passing comment. It enters into the fields of science, commerce, domestic economy and civic advancement. It is light which is needed now more than ever before. The old days, when those that could read used the firelight or the flickering rays of a torch, have fortunately passed. But it must be admitted that, though passed, the advancement from this illumination to the apparent triumph of employing electricity is more fancied than real. Throwing away 99 parts of a useful thing in order to use but one part cannot be consistently regarded as a sign of such remarkable progress. It is admitted that great advantages have been gained, but not to the extent that might have been inferred from the progress in other directions.

Yet better prospects have appeared in the form of a tantalum lamp; a lamp whose filament is made of tantalite. What is tantalite, and why is it so advantageous to use instead of carbon? "Tantalite occurs in nature in various minerals. There are two groups of tantalite ores—tantalite and columbite. The tantalite ores, found in Australia and Scandinavia, contain tantalite of iron and manganese. From these ores tantalite is first separated as tantalic acid, which is converted into a double fluoride of tantalite and potassium, from which tantalite is derived as a pure element. The real discoverer was Eckeberg in 1802, and another experimenter was Berzelius in 1824. Doctor von Bolton, of Germany, obtained pure tantalite after laborious experiments. It is a heavy mineral, with a gray metallic luster, resisting acids and alkalies. It has the hardness of steel and great tensile strength, and can be worked into thin sheets and fine wires. It melts only at an enormous temperature, somewhere around 4,000 degs. F., and becomes, through annealing, hard enough to withstand a diamond borer." According to reports of tests, this high temperature withstood by tantalite makes lamps employing it take one-half the current, and give twice the light of those using the same power with carbon. It lasts, too, from 100 to 400 hours, giving full candle power throughout. Costing, as is does, $5,000 a pound, may hinder its general usefulness, but it seems to exhibit qualities that place it in advance of all types of its kind extant. Let the art of lighting permit the critical point of temperature to be safely passed and the battle is won. Perhaps in tantalum lamps we may find a means of advancing far beyond the historic torch of our forbears.

* * *

Electric Railways.

The day is unquestionably coming when the principal railroads of the country will discard the steam locomotive and adopt electricity as motive power. As is generally known several railways in this vicinity are about to give the electric locomotive a trial over comparatively short stretches of track, and now we hear that the New York, New Haven & Hartford Railroad intends in the near future running electric trains from here to Boston by means of the single-phase alternating current system.

It is interesting in this connection to note that the subject of electrically operated railways was taken up and discussed by the British Association at its recent meeting in South Africa. There was no paper devoted expressly to this matter, but an interesting debate upon it followed upon a paper on the Cape Government Railways, contributed by Mr. A. M. Tippett, the chief resident engineer of that system. The electrical question was introduced by the chairman of the section, Mr. R. H. Hammersley Heenan, who mentioned it as the burning matter of the year, and Sir William Preece followed with various remarks, which went to show that electric railway traction was in a very tentative state both in England and America. He described the recent main line electrical work on the third rail principle at Liverpool and Newcastle as being representative of an obsolete system, and seemed to give his blessing to the single phase alternating current system with overhead conductors. He said that it would not be long—seeing the intention of the London, Brighton & South Coast Railways to equip a London suburban section on this principle—before there would be a splendid object lesson both of continuous and alternating railway working in London. Then English railway men and electrical engineers, too, would be able to compare the relative advantages. Many men seemed to think that the whole and sole question was the relative cost of working the line by electricity as against steam. But, said Sir William, it was rather the advantage that the current would have in expediting the rate at which they could get on their speed and maintain it in working their line.

Mr. Robert Hammond followed with remarks couched in a similar vein, illustrating the benefits accruing from higher accelerating power, and he ended quite characteristically when he said he trusted that next time the British Association went to South Africa they would find that something had been done in regard to railway electrification.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

A cable dispatch says that a lockout in three of the greatest electrical companies in Berlin began last Saturday afternoon. It affects all the factories of the Allgemeine, the Siemens & Halske and the Siemens-Schuckert companies except one lamp factory, and throws 33,000 workmen out of employment.

The Electrical Section of the Western Society of Engineers will hold its first meeting of the season on Friday evening, October 13, in the Society's rooms in the Monadnock Block, Chicago. A paper will be presented by Mr. James R. Cravath on "Do We Need Better Illuminating Engineering?"

A French contemporary describes an electrically operated railway for the transmission of mail and packages. Trials have been made on a circular track of 1,640 feet radius. The car used is 28.8 feet long by 3½ feet wide, and weighs 6¾ tons. The speed aimed at is 156 miles an hour, and this has been readily attained on trial. The car runs upon a single rail, but is guided by guide-wheels bearing on opposite sides of a special guide-rail. There are two driving wheels driven by belting from three-phase motors taking current at 1,000 volts and at a periodicity of 40 cycles per second. It has been found that the speed of 156 miles an hour was attained in five minutes from starting, and on the current being cut off the vehicle came to rest again after the same lapse of time. The retardation on cutting off the current can, however, be greatly increased by means of wind resistances, which are folded down flat on the car when it is running, but are opened out automatically when a certain string is cut by a fixed knife interposed in the path of the car.

An exchange says it is to be noted that Mayor Dunne of Chicago is still bumping the bumps on the rocky road to municipal ownership.

Of what young men think of electrical work as a profession there is a suggestion in the preferences of the students at the Brooklyn Evening Trade School. Of 1,070 students 226 have chosen electrical engineering and 102 electrical wiring as against 16 who selected blacksmithing, 50 tinsmithing and 30 pattern-making.

The Polytechnic Association, a section of the American Institute of Electrical Engineers, will discuss "Trade Marks" at its meeting in the Institute Hall, 19-21 West 44th street, this city, Thursday evening, October 5.

The Rowland Telegraphic Company will exhibit a quadruplex apparatus at the Milan Exposition of 1906, probably under the auspices of the Italian Government. The project of an entire change in the operation of the Italian telegraphs, based upon the introduction of the Rowland system, is now actively before the Italian Parliament.

An unusual feat in wireless telegraphy was accomplished last week in the transmission of an aerogram from the station at Newport, R. I., to the Washington Navy Yard, a distance of 320 miles. Owing to the fact that the waves traveled over both land and sea, the incident has attracted more than ordinary interest at the Navy Department.

President Ely of the American Street Railway Association says it is only a question of a very short time when the trolley roads will become very strong competitors of the steam lines for the local freight carrying business as well as local passenger traffic.

A NEW REFLECTING LANTERN.

BY A. FREDERICK COLLINS.

Those who have magic lanterns or stereopticons very often would like to project some object or print upon the screen, but to do this would mean the making of a photographic reproduction on glass, and usually this procedure is impracticable either for want of time or because it would be too expensive.

Many years ago some genius invented a miniature reflecting lantern for showing opaque objects, and he called it the "polyopticon," but this little toy did not meet with any great success, for the reason that the picture so thrown upon the screen was not nearly bright enough, large enough, nor was it at all clearly defined.

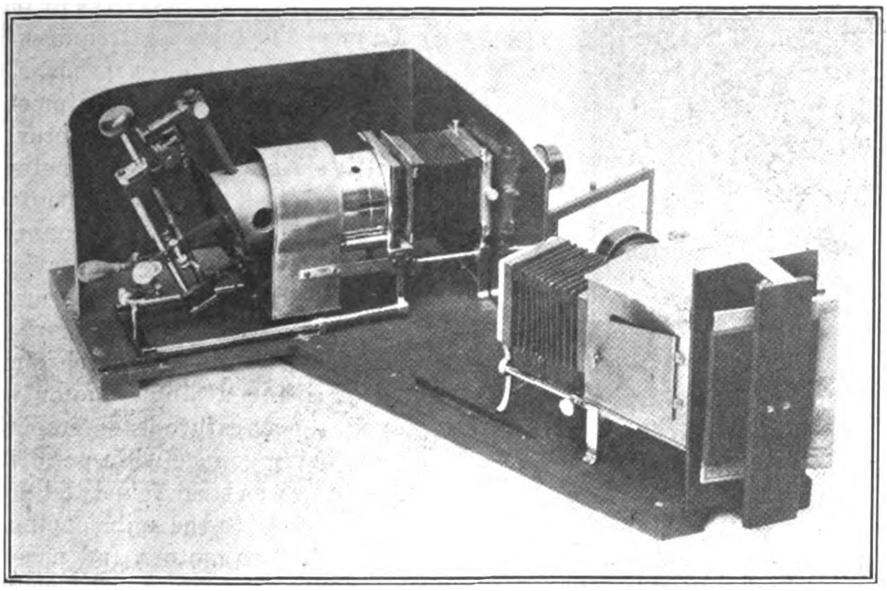

Fig. 1.—View of Reflecting Lantern Arranged for Showing Lantern Slides.

However, this plaything embodied the right principles, and its failure as a scientific instrument at the time it was brought out can easily be traced to defective lenses and poor light, for the art of luminous projection by electricity had at that period not been developed even for stereopticons, the lime light being the brightest source of illuminating power then available.

Since the introduction of the polyopticon there have been many improvements made tending to adopt it to practical purposes, and this evolutionary progress has resulted in the instrument shown in the illustrations.

The great improvement in the new reflecting lantern is primarily the source of light and by means of a dispersing lens the light is as evenly distributed and the screen as brightly illuminated as though the light was refracted through a slide instead of reflected from an opaque object. The complete apparatus comprises a regular projecting lantern for showing the usual glass slides, and to this is fitted a 90 degree hand feed electric arc lamp. This projector and the reflecting lantern attachment are mounted on an interchangeable base, so that lantern shows or ordinary pictures can be shown as desired, the change being made almost instantly.

Fig. 1 shows the projecting lantern adjusted for using ordinary glass slides and Fig. 2, after the change has taken place, the bellows of the first being connected to the bellows of the reflecting lantern with the dispersion lens being placed between them. In Fig 2, the arc lamp is represented by 1, the projecting lens at 2, the dispersion lens, referred to above at 3, the reflecting chamber at 4, where the angle of the rays of the arc light are changed from the print or object in the holder 5, through the objective lens 6, where it is again made to change its angle of incidence by the mirror 7, whence it is projected upon the screen as shown in Figs. 3 and 4.

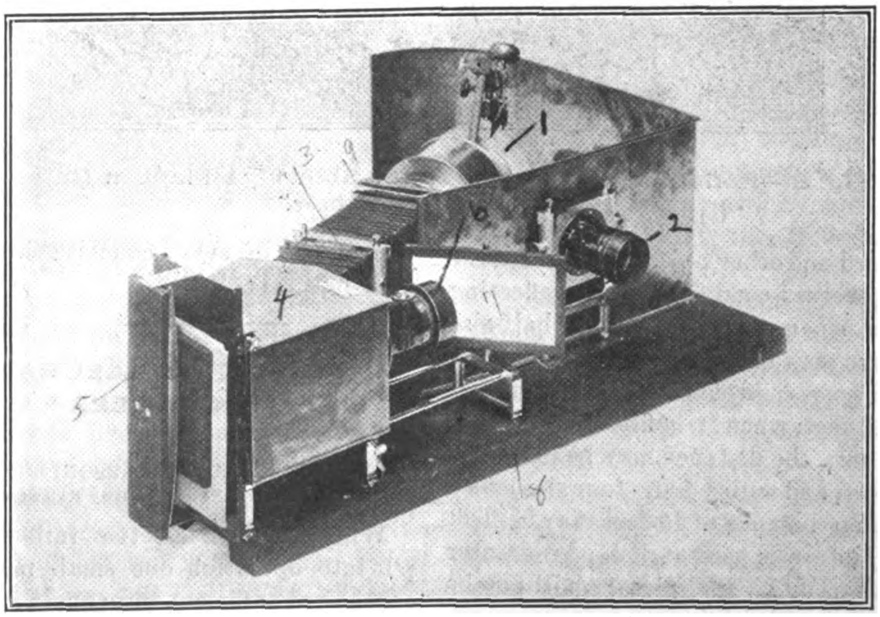

Fig. 2—View of Reflecting Lantern Arranged for Showing Reflected Pictures

The object holder 5 is an ingenious contrivance that has done much to popularize this form of lantern. This device is arranged so that it may be attached or detached instantly and yet its size has really nothing to do with the metal body of the lantern to which it is fastened. That is to say, the holder is adjustable within wide limits and an open book of ordinary size may be held so that any of the pictures on any portion of the page may be thrown upon the screen without the slightest injury to the volume, or the smallest card or cut may be held just as securely.

The value of a flexible object holder of this description can only be appreciated by those who have had to contend with those formerly on the market, and which generally consisted of a hinged door equipped with a set of spring clips to hold the picture, which if too large had to be cut to make it fit, and as it is frequently desirable to show pictures and designs in books, the scheme was quite impracticable. Another strenuous objection to reflecting lanterns of the past, and which in the present one is entirely obviated, is that the edges of the picture projected on the screen would show and tend to be confusing, especially in cases where they were blurred. In the instrument under consideration this untoward feature is overcome by the very simple expedient of using a diaphragm at 9, which represents the slide chamber of the ordinary lantern, and by this means all the light from the edge of the picture is cut out, forming a clean-cut block frame. Another interesting improvement is found in the method by which the operator is given absolute control over both the size and finish of the picture; this is accomplished by the lens at 3, and by moving this forth and back an adjustment may be obtained so that any picture from one to five inches square, may be used.

The object of the mirror 7 is to cause the picture when reproduced on the screen to assume its natural position, or otherwise printed matter would read backward and other objects would appear in a reversed condition. The reflecting lantern when supplied with a half-size objective can be used at any distance from the screen providing it is not greater than 20 feet; when it is fitted with a two-thirds size, the distance may be increased to 30 feet, and with a four- four size lens a maximum distance of 40 feet may be had. If the lantern is used at distances greater than those cited, the picture will not be as brightly illuminated, as its size rapidly increases.

The sheet iron shield, shown at the side and front of the lantern body, is arranged to keep rays of light from the lamp from reaching the screen or the audience. To get the best results with the reflecting lantern, the arc lamp should be fed with a current of from 20 to 25 amperes, and to obtain the right amount of current an adjustable rheostat is furnished. The instrument is not at all expensive considering its vast utility, and can be purchased for less than $50, where the reflecting attachment only is needed, but where a projecting lantern must be had the price is approximately double this amount. With the combination, however, the lecturer has at his command means for projecting images, magnified many fold, and objects of every conceivable kind in their natural colors.

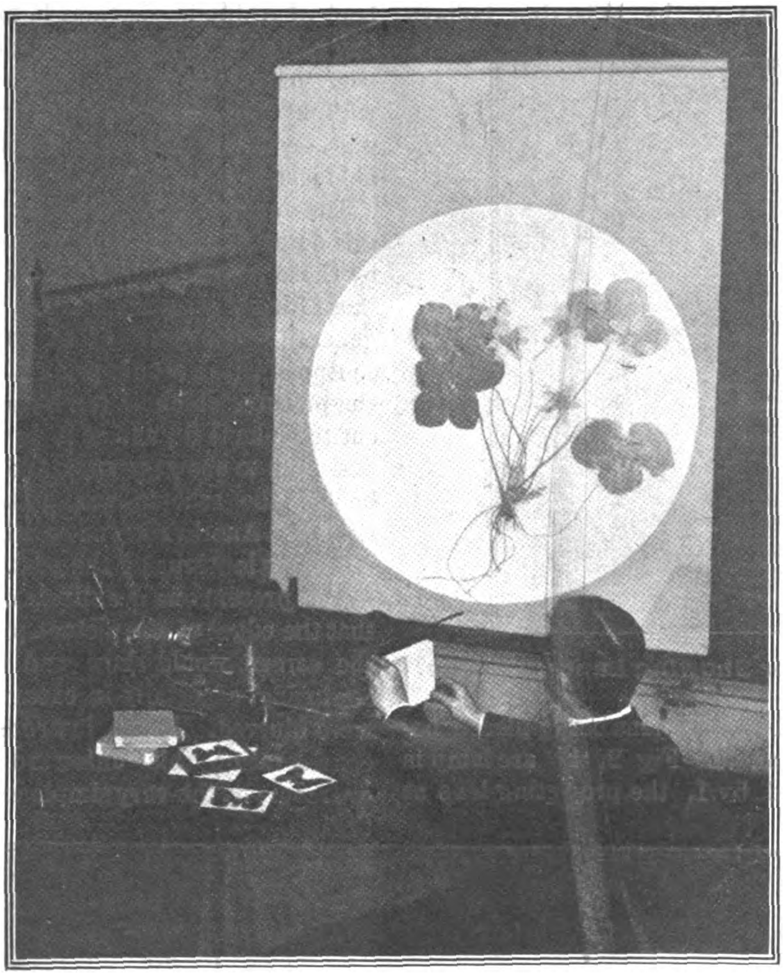

Fig. 3.—Reflecting Lantern Used for Showing a Plant in Natural Colors on the Screen.

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THE SERIES-PARALLEL RAILWAY CONTROLLER.*

BY W. A. PEARSON,
Electrical Engineer New York City Railway Company.

When the first electric railways were put into operation one small motor was considered sufficient to propel a car.

On some of these early equipments in which shunt motors were used, the brushes were designed to be moved around the commutator for the purpose of reversing the direction of rotation, it being considered impossible to provide the same neutral commutating points for both directions.

In developing the series motor it was found that common neutral points for both directions of rotation could be produced, permitting the use of a double pole, double throw switch for reversing the connections of the armature leads.

The simplest way to start and control the speed of the single motor was to use a dead resistance in series with it. This method, which was adopted, has been successfully used for single motor equipments since the earliest days of the art.

To meet the increased requirements of heavier cars and higher speeds, a second motor was added to the equipment. As the rheostatic control had proved sufficiently satisfactory for one motor equipment, it was also considered suitable for two motors permanently connected in parallel. Consequently a heavier rheostat was used with two motors connected in this manner.

At first a reversing switch similar to that used for a single motor was employed, the armature leads from the two motors being connected in parallel. This connection was soon found to be impracticable owing to the unbalancing of the load on the two motors, and necessitated the use of separate reversing switches.

In order to obtain an efficient running speed at somewhat less than the full speed of the motor, several methods of varying the field strength were tried with different degrees of success. Some motors were provided with field taps, or "loops," the full field being intended for use in starting and ascending heavy grades.

The field strength was weakened by cutting out a portion of the winding by means of the tap, thereby allowing more current to pass through the armature, increasing accordingly the speed of the motor. Another method consisted in connecting sections of the field coils, first in series and then in parallel, to produce different field strengths. These two methods were used for a few years, and finally abandoned owing to troubles resulting from the burning out of field coils. In the next field variation method that was used, a resistance was placed in shunt around the fields of each motor, thereby accomplishing the same result but in a somewhat different manner. This also led to complications, as motors were operated under such varying conditions. In some cases the full field point was used excessively by the motorman, the coils becoming overheated, and in other cases the shunt point was used too much on heavy grades, resulting in armature and commutator troubles.

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*Paper read at the annual convention of the American Railway and Mechanical Association, held at Philadelphia, Pa., September 25-26, 1905.

Field variation for obtaining speed control was abandoned by the manufacturers of railway motors about nine years ago, and since that time but two speeds have been provided without series resistance in controllers supplied with two motor equipments.

About fourteen years ago the attention and energies of manufacturers of railway apparatus were applied to the development of a control for two motors which, when starting or running slowly, would waste less power than the rheostat and would permit running efficiently at half speed.

The method which seemed to promise the best result was to start the motors in series, and after they had reached their full speed for this position, reconnect them in parallel. Many different experimental controllers were constructed in the attempt to produce a satisfactory piece of apparatus.

Nearly all original electrical apparatus was crude as viewed from our present standpoint, to which view these early series-parallel controllers formed no exception.

One of the forms was fan-shaped with a stationary slate board to which were secured the motor, resistance and other contacts, with a movable arm, pivoted at its lower end, and adapted to move from side to side of the slate board, thereby making the necessary circuit combinations. This form was defective for two reasons. The circuits made were not suitable for giving proper speed variations and no adequate means were provided for breaking the arcs formed at the contacts. Several different manufacturers attempted to design controllers of this shape, both for single motors and two motors, but without success.

A more successful series-parallel controller was brought out in 1892, which was located beneath the car and operated by means of rods and bevel gears from either platform. This controller was used in conjunction with the same reverse switch as was used with the rheostatic control. It was expected to fill the great want, but after several hundred had been put into service it was found that improvements were necessary. The starting of the car with this form of controller was jerky, as an insufficient number of points had been provided, while the impossibility of properly installing the controller under the car, so that lost motion in the gears would not be excessive, produced serious burning at the contacts.

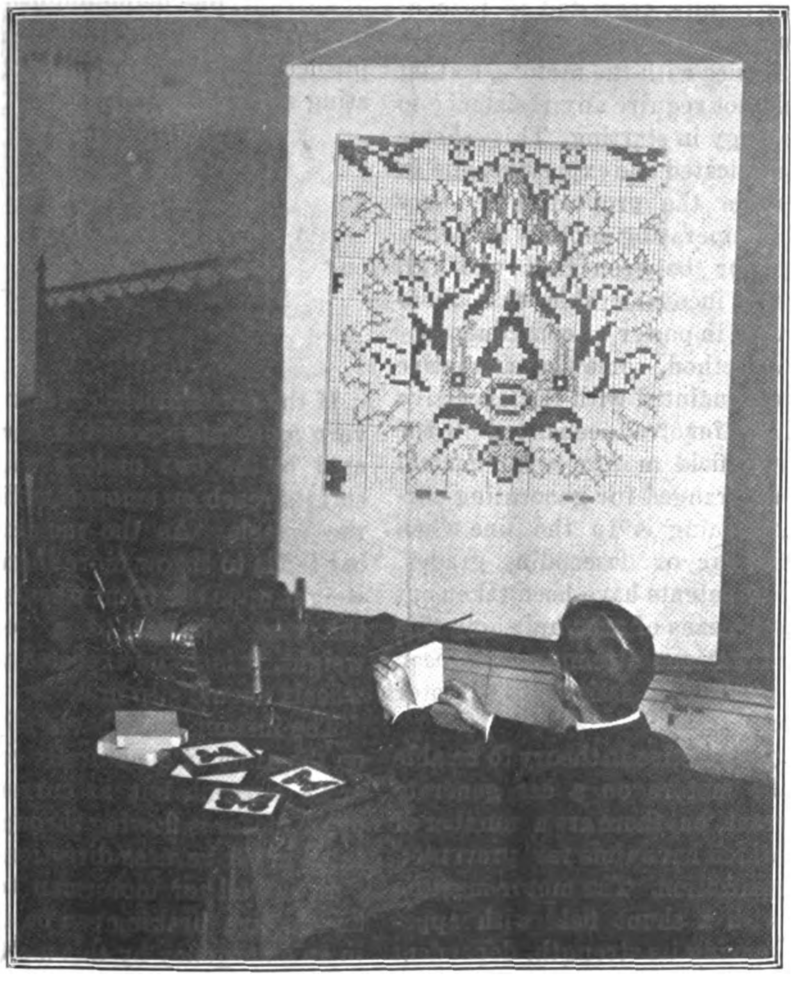


Fig. 4.—Reflecting Lantern Used for Showing a Textile Design Upon the Screen, the original being mounted on a plain card.

This controller contained a magnetic blowout for disrupting arcs, which was very much superior to anything made previously and which served its purpose in proving the value of the magnetic blowout. It was also the first controller which shunted one motor in passing from series to parallel.

At about the same time another form of series-parallel controller was brought out by another manufacturer, in which a cylinder was used in conjunction with stationary contacts, or fingers, for producing the different resistance and motor combinations. As it was installed on the car platform it did not require operating mechanisms and was in consequence simpler in construction and not liable to the troubles due to lost motions in transmitting the turning effort from the operating handle. This controller also met with partial success, although the arcing at contacts was considerable, which, in the absence of the magnetic blowout, caused the principal trouble.

These two forms of controllers clearly demonstrated the practicability of series-parallel control, and demonstrated that the magnetic blowout to take care of arcing, and the cylinder for compactness and simplicity, were necessities in the design of a controller for operating two motors of the capacity about 30 hp., then used.

The final outcome of the series-parallel controller for street car service was the present well-known K type, which has been practically standard for about 12 years.

This controller owes its success very largely to the form of magnetic blowout employed for extinguishing the arcs formed in opening the circuits and the method of making the transition from series to parallel.

Other forms of magnetic blowouts differing in detail have since been designed which have operated satisfactorily, but the form used in the K type of controllers was the first to be made commercially successful.

In this type of controller, after the motors have reached the full series position, a portion of the starting resistance is quickly reinserted in the circuit and a shunt is put around the No. 2 motor by connecting E^1 to ground, thereby eliminating that motor from the circuit, as shown in Fig. 1.

Immediately after this circuit has been established the connection between No. 1 and No. 2 motors is broken, and the positive lead to armature of No. 2 motor is connected to the rheostat, while the line current then passes to No. 2 motor and the motors are in parallel, as shown in Fig. 2.

In the L type of series-parallel controllers, instead of maintaining the current through one motor during the transition, the circuits of both motors are broken. This method of passing from series to parallel was adopted in railway controllers for motors of a total of over 250 hp. It was found that the arcing in the controller when using the K type of connections was too great to permit their use in large controllers.

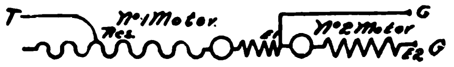


Fig. 1.

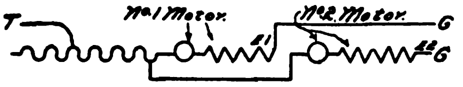


Fig. 2.

In the development of multiple unit control it was found that a better method of making the change from series to parallel, which had been proposed before the first K type of controller was made, was possible with separately actuated switches or contactors. This is what is known as the "bridge method," and consists in keeping the current on both motors during the transition. Each motor is provided with a separate resistance, and when full series has been reached the connections are as shown in Fig. 3.

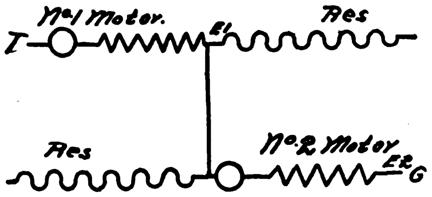


Fig. 3.

When passing from series to parallel the first transition step is with resistance for No. 1 motor connected to ground, and resistance for No. 2 motor connected to trolley, as shown in Fig. 4.

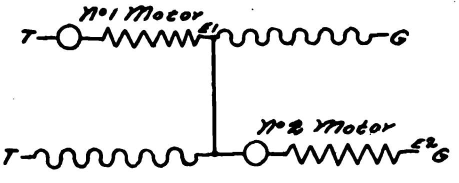


Fig. 4.

It will be seen that this last step has put the two motors in multiple with an equalizing connection between E^1 and the positive side of the armature of No. 2 motor. This equalizer is next open circuited, and the motors are in the first parallel position.

This method of making the series to parallel change permits a somewhat smoother acceleration than with the K type of connections, but it is not essential for light equipments where great smoothness is not such an important consideration as on heavy cars operating with multiple unit control.

Several attempts have been made to produce a control which would be still more economical in use of power than the series-parallel method now in use.

One of these, on which a considerable amount of ingenuity has been expended by different inventors without producing satisfactory results, consisted in providing a "counter electromotive force generator" in series with the motors, so that they should not require any resistance to consume energy in starting. This scheme proved complicated and expensive, and in actual service the proportionate time consumed in operating motors at below half speed, or between half and full speed, was so inconsiderable that there was no saving in power of consequence.

Another method, somewhat attractive to those unacquainted with the excessive complications involved, consisted in the use of shunt field motors with control connections arranged for generating current and returning it to the line when stopping the car or descending grades. A number of patents have been taken out for different means of accomplishing this result, and various attempts have been made to produce a satisfactory motor and control.

It is very attractive in theory to be able to make the motors on a car generate useful current, but there are a number of obstacles which have thus far prevented practical realization. The motor must be provided with a shunt field with apparatus for varying its strength, dependent upon the speed while braking, and apparatus must also be provided for giving practically a straight series field for starting.

In addition it is necessary to connect the armatures in parallel and series relation for braking, according to the speed of the car. When the armatures are in series, and the field strength is at a maximum, the minimum car speed at which current at line potential may be generated is obtained. It is obvious that when the car is moving at a speed less than this critical speed, the motors will be taking current from the line instead of furnishing it.

On a K-10 controller or similar two-motor equipment, it is a well-known fact that in an emergency the car may be stopped when the trolley is off, or main fuse blown, by throwing the reversing handle to its backward position and turning the controlling handle around to multiple. The connections made are such that the two motors are really connected in series, as shown in Fig. 5, but in such a manner that the voltages of the two armatures oppose each other. If these voltages were exactly the same there would be no flow of current, and consequently no braking. As a matter of fact no two motors are identical, and the slight difference in initial voltage gives one motor predominance over the other and determines the direction of the flow of current, one being obliged to reverse its polarity. This can be readily accomplished as the changing motor is operating as a series generator.

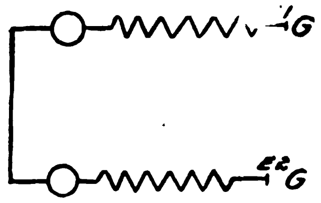


Fig. 5.

If the car is moving at any more than a very moderate speed the current generated by the two motors will almost instantly reach an amount sufficient to slip the wheels. As the momentum of the car tends to throw more than the normal weight upon the front wheels, and relieve the rear wheels of a corresponding weight, it is to be expected that the rear wheels should slip first.

The instant the wheels slip the motor on the same axle naturally ceases to generate current, but as current from the other motor is flowing through it, it is rotated in the reverse direction as a motor.

It is well for motormen to know that an effective braking can be accomplished in an emergency by this method.

On four motor equipments where two motors are connected in multiple, it is only necessary to throw the reverse handle to cause the motors to generate, as the circuits are already made, and it is only necessary to reverse the relation of armature and fields.

With a four-motor equipment, care should be taken that the car is brought to rest before the reversing handle is returned to its forward position, otherwise the contacts are liable to be burned. A recent controller, known as the K-28, has been provided with extra air space in the vicinity of the reversing contacts, while barriers are located between them, so that the chance of injuring the reversing switch when "bucking" the motors has been removed.

When motors have been used with electric brakes the controller made connections somewhat different from the foregoing, as it was necessary to vary the quantity of current taken and divide the load equally. Fig. 6 shows the connections.

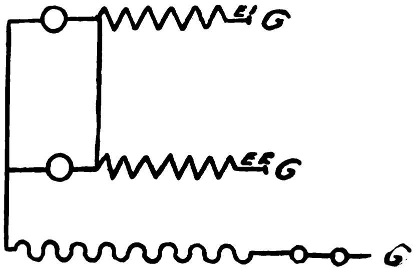


Fig. 6.

Electric brakes have not proved very satisfactory, principally for the reason that their action was too irregular, and they could not always be depended upon. In order to generate current satisfactorily it was essential that the commutator should be in good condition. A comparatively slight increase in the resistance of the circuit caused by a dirty commutator or loose connection would prevent a motor from building up at a certain speed.

Due to this irregular action in the motor it was sometimes difficult to make a smooth stop with electric brakes.

It was also found that the high voltage and additional duty imposed upon the motor was productive of commutator trouble and overheating.

The duty required of a street car controller has gradually increased. Instead of two 30 hp. motors as formerly, four larger motors are now controlled in the same space. Voltages have been increased and the capacity of the line also raised, so that when an extraordinary arc occurs in a controller from any cause the damage is greater than formerly.

For this reason it is especially necessary to keep fingers properly adjusted, segments renewed and connections tightened to avoid troubles on the road.

There is a growing tendency to place controlling apparatus for large and medium size motors under the car. It removes the heavy capacity parts from the platforms and not only leaves a greater passenger space but also eliminates all possibility of danger from controller "blow ups."

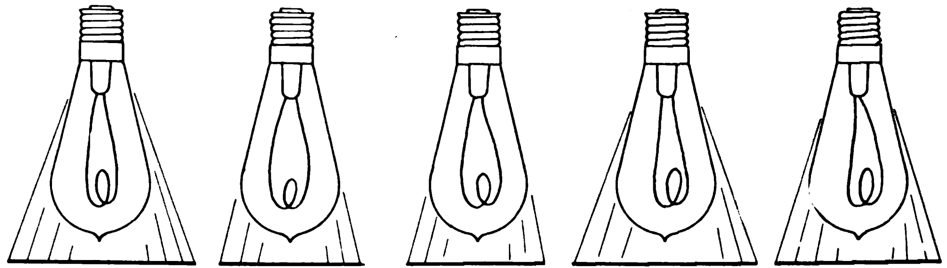
Wireless on Moving Trains.

Wireless telegraphy on moving trains has been demonstrated to be practical, according to a report of Consul-General Guenther, of Frankfort, Germany, to the Department of Commerce and Labor at Washington. Trains equipped with wireless telegraphy on the Zossen-Berlin military road for the last two years have been able to communicate at all times with telegraph stations along the line, and to report instantaneously any irregularities or accidents. The aerograms are likewise sent from stations to moving trains.

LIGHT, HEAT AND POWER PRINCIPLES.—II.

BY NEWTON HARRISON, E. E.

Selection of Lamps.—The distinction to be drawn between one form of lighting and another is largely determined by the character of the illumination in view. From a broad standpoint, the difference is that of interior from exterior lighting. The lighting of office buildings, theaters, large halls and private dwellings, differs in the nature of the lamp required, when compared with the street. In the first case, many small centers of illumination become the means by which a comparatively uniform degree of lighting is secured. In the second case, more intense centers of illumination are the foundation for an outside system, by which the streets of a city are lit up over a series of contiguous areas. In the majority of cases where lighting is done the light is so developed that it falls directly upon the areas to be brightened. The light is not, as a rule, cast upon a given surface and then reflected downwards or sideways. It is the object of lamp manufacturers to avoid, as far as possible, the dispersion of light, or its undue absorption through an inefficient and unscientific method of distribution. Although globes of all shades and colors are brought into commission, their use is only necessary because of the disagreeable intensity of the light, and the desirability of shading or toning it down. Different colors are effective, from an æsthetic standpoint, in the production of pleasing hues; but any method which affects the color also diminishes the light. Ground glass, as well as opalescent shades or globes, are very wasteful in this respect. The resulting condition of affairs in the lighting field is somewhat illogical, for the reason that knowledge and skill are brought into play to develop a highly efficient generating, transmitting and distributing system, with regard to the electrical energy involved; and this, when transformed as far as possible into light, is permitted to pass through globes and screens, by which from 10 to 40 per cent. or over is wasted. Meter measurements, indicating excellent judgment in the method of generating electricity, when contrasted, in some instances, with the returns obtained from candle power measurements, seem to show light losses of a serious nature. A given amount of power is productive, with modern lamps, of a given amount of light. In other words, a certain weight of kerosene oil, from which a horse power could be obtained, if exploded in a gas engine; a certain number of cubic feet of illuminating gas similarly utilized; a given weight of coal burnt in a steam boiler, or oil used as fuel for the same purpose; a horse power of mechanical energy obtained from a water fall; all of these are sources of power which, with respect to lighting, produce a certain amount of candle power. Power therefore represents light when so transformed; and it merely becomes a question of the means or mechanism employed, as to whether the tranformation results in much or less light. Using screens or shades, however, which absorb a heavy percentage of the light, is equivalent to using defective machinery in the way of inefficient boilers, engines, dynamos or conductors, causing too heavy a line loss.



Light Wasted with Different Screens.

Returns from Generators.—Generators of different horse power vary with respect to the returns they give when set into operation. A 1 hp. dynamo is necessarily less efficient than a thousand horse machine. The percentages of efficiency increasing, with the capacity of the generator, is to have been expected, as shown by the following table:

Power of generator in kilowatts.	Percentage of efficiency.
1	60 to 70
5	70 to 80
10	80 to 90
15	85 to 90
20	87

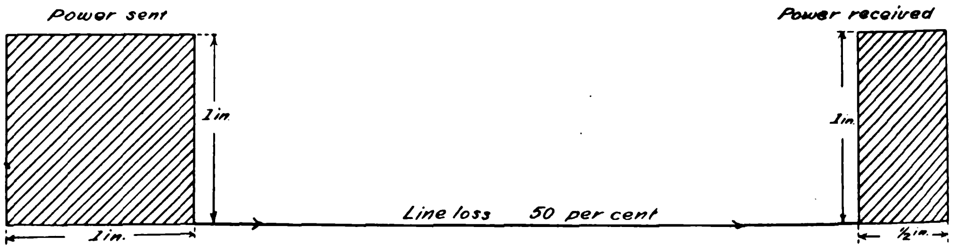
Power of generator in kilowatts.	Percentage of efficiency.
25	89
30	90
40	91
50	92
60	92.5
80	92.5
100	93.0
150	93
200	93.5
300	94
400	94.5
500	95 to 96
1,000	96 to 97

Cost of High Efficiency.—One of the best rules followed by conservative engineers is that of not reaching out for a too expensive efficiency. By this is meant, the efforts made to overtop the market or commercial efficiencies a few per cent., at a cost all out of proportion to the benefits gained. As an example of this false economy, suppose a generator costs $1,000 and possesses an efficiency of 90 per cent. If it costs the manufacturer an extra $200 to gain this few per cent. more, then whatever economic advantages supposed to arise from the few per cent. additional efficiency are lost through the following: First, the additional investment and the interest it represents; second, the additional difficulty of making sales through the higher price; third, the necessity for special attention to preserve the advantages paid for; and fourth, the inability to control losses in light through its faulty manipulation when developed. For these and perhaps additional minor reasons, the cost of high efficiency is sufficiently prohibitive, when obtained by too heavy an additional investment, to be a practical commercial proposition. The durability and amount of care required to give uniformly good returns are the governing influences in the selection of dynamos and motors. For equal investments, the machine of the most solid construction is by far the better choice.

Elements of Power.—The method of calculating electric power is based upon the pressure in volts and the current in amperes. These are the elements of power for either direct or alternating currents. In the case of a direct or continuous current, both the volts and amperes operate as elements of power simultaneously. In the case of an alternating current, the volts and amperes may not operate simultaneously as elements of power. For this reason, in the latter case, the amount of power is calculated with reference to that condition or conditions which prevent the co-operation of the pressure and current at the same time.

Continuous Current Calculations.—For measuring the pressure in volts or the current in amperes both volt and ampere meters are employed. These instruments are so devised that the current passing through produces a magnetic field. The extent to which this field is manifested is, in a general way, the measure of the number of volts or amperes in the circuit.

For instance, in a voltmeter of the standard Weston make, more volts or less volts produce through its fixed resistance more or less current; which produces a stronger or weaker field; a stronger or weaker mechanical pull against a coiled spring; and in consequence a greater or less range of indication of the pointer showing the volts in the circuit. In the same manner an ammeter permits the current to operate similarly. Instead of the current passing through a low resistance in the voltmeter, the resistance is made as high as possible. By this means the voltmeter takes only sufficient current to actuate its mechanism. The resistance of a 150 volt reading meter of the Weston construction, ranges from 10,000 to 20,000 ohms. The amount of current abstracted from the source being measured, is thus reduced to a very low figure; sufficiently low, to make no impression upon the records given by the ammeter, when both instruments are in operation simultaneously on the circuit. The ammeter is constructed with just the opposite idea in view. Its resistance is made as low as possible, so that when current measurements are taken, its resistance is not the cause of drop in the instrument. For this reason the resistance of an ammeter will be as low as a few ten thousandths of an ohm. In one instrument as little current as possible is consumed, in the other, as little of the voltage as possible is dissipated.



Sketch Showing Power Lost in Line.

Power is measured in watts, or in quantities of a thousand watts at a time, called kilowatts. Watts are obtained by the product of volts and amperes. Taking a specific case, supposing 1,000 volts and 50 amperes are impressed upon a line of 10 ohms resistance. The power in watts and kilowatts, the drop, the watts wasted in heat, and the percentage of efficiency in the line as a conductor will be as follows:

Total power impressed upon the line = 1,000 × 50 = 50,000 watts.

Total power impressed upon the line = 50,000 ÷ 1,000 = 50 kilowatts.

Total volts wasted in the line = 50 × 10 = 500 volts.

Total power delivered at the other end = 500 × 50 = 25,000 watts.

Total power delivered at the other end = 25 kilowatts.

Total power wasted as heat in the line = 50 × 50 × 10 = 25,000 watts.

Total power wasted as heat in the line = 25 kilowatts.

Total efficiency of the line = 25,000 ÷ 50,000, or 50 per cent.

Sources of Power.—A variety of sources of power exist, which may be variously classified for convenience. These sources of power may be natural, as those supplied by the earth, water or air, or they may be artificial, that is, produced by mechanism and fuels of different character. As regards the natural sources of power they may be arranged in the following manner:

I.—SOURCES OF NATURAL POWER USED BY MEANS OF MACHINES ADAPTED TO THEM.

Air as utilized by means of wind mills for developing rotation.

Water (falling) as utilized by means of water wheels for developing rotation.

Waves as utilized by means of pumps for developing rotation.

Tide (if fast) as utilized by means of water wheels for developing rotation.

Tide (if slow) as utilized by means of floats for developing rotation.

Sun's heat as utilized by means of mirrors and steam engine.

II.—SOURCES OF ARTIFICIAL POWER USED BY MEANS OF MACHINES ADAPTED TO THEM.

Coal as utilized by means of steam engines, steam turbines and rotary engines.

Gas as utilized by means of gas engines.

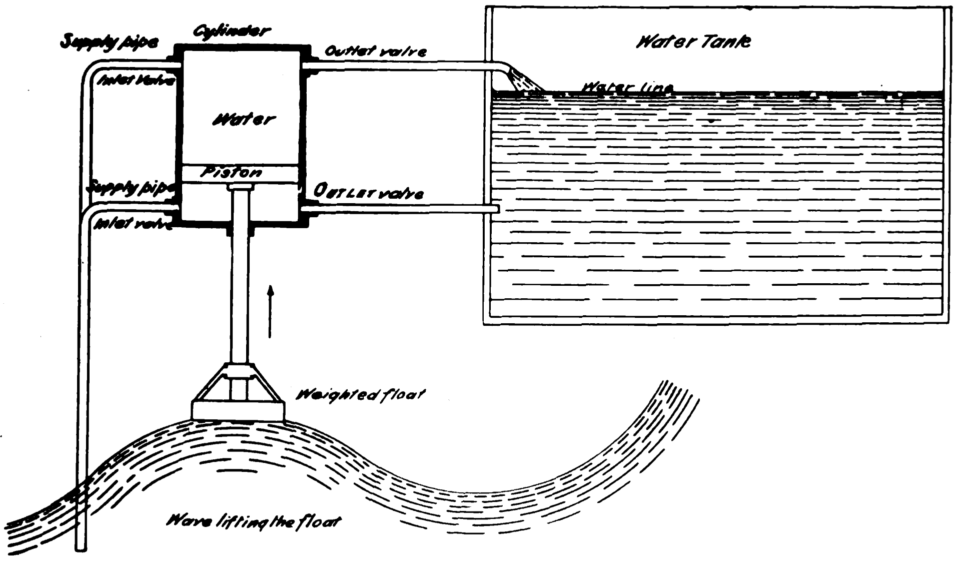
Oil as utilized by means of gas engines, or for producing steam.

Wood as utilized by means of steam engines.

Alcohol as utilized by means of engine specially constructed.

Compressed air as utilized by means of engine specially constructed.

As may be readily noted, this classification is more or less arbitrary, because of the difficulty of separating the purely natural from the artificial sources of power. But the line of distinction is somewhat strongly drawn, by the fact that in the first case no heat is directly or indirectly applied by man; while under the second heading, heat or an explosive spark, or both, is produced, either at the beginning or end of the process. The use of wind mills and water wheels may be found throughout European countries as one of the first acknowledged sources of natural power; the first, in fact, to displace manual labor or that of animals. In Holland particularly, wind has served this purpose from time immemorial. In Switzerland, water power, came into frequent employment, the source being the mountain torrents formed by the melting of ice masses or prehistoric glaciers.



Principle of a Pumping Wave Motor.

In the neighborhood of the Jersey coast, experiments have been conducted with wave motors built upon unique lines. The oscillating and up and down movement of the waves is employed to operate a series of small pumps. These pumps force water into a huge tank against considerable air pressure. The water thus pumped in is under such pressure that when permitted to escape, it is capable of operating a water wheel or turbine in the same manner as a stream falling from a height productive of the same impact. The quantity of power obtainable on this basis makes it a proposition of great interest. The erection of strong steel supports, and other means of resisting the violence of the sea, constitutes an item of expense that merits conservative consideration. A few figures in connection with wave power will be of interest.

Power from Waves.—A cubic foot of water weighs 62.5 pounds. If it is lifted 5 feet and then permitted to fall, each operation will call for a manifestation of mechanical power equal to 5 × 62.5 = 312.5 foot lbs. The total energy is equal to 2 × 312.5 = 625 foot lbs. A wave rising and falling once every one, two or five seconds, would rise and fall 60, 30 or 12 times a minute. With these figures as a foundation, the foot lbs. developed are equal to 60 × 625, 30 × 625, or 12 × 325; equal respectively to 37,500, 18,750 and 3,900 foot lbs. per minute. As there are 33,000 foot lbs. per minute to a horse power, these cases represent conditions productive of more than 1 hp. $\frac{1}{2}$ hp. and $\frac{1}{10}$ hp. In a vertically situated pump, whose piston rod is weighted to keep the piston down until lifted by the advancing wave, a series of reciprocations will be possible, the power of which can be readily estimated. The wave must lift the piston rod in this case, through the medium of a buoyant mass attached to it, yet sufficiently heavy to drop downward when relieved of the force of the wave. Along a hundred feet of shore line, devices of this kind properly arranged would easily operate, and pump water into the receiving reservoir at all times. It is a matter of simple calculation to see how large a source of power can be derived from a system of this character. It would not be too far fetched a statement to make, to say that along the Atlantic coast, millions of available horse power in this form could be turned to a useful purpose.

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The Great Berlin Street Railway Company has increased its capital $15,000,000 and will construct subways under several important streets of Berlin, Germany.

WRINKLES.*

EDITED BY H. C. ABELL.

An Improved Voltmeter Multiplier.

An occasion came up some time ago to measure a 370-volt circuit; no voltmeter of sufficient capacity was at hand. A 150-volt voltmeter was connected in series with the resistance box of a Wheatstone bridge, and plugs were pulled out until the resistance was twice that of the voltmeter, the voltmeter thus indicating one-third the applied voltage. These standard resistance boxes are wound non-inductively, and can be used in connection with either direct or alternating currents. It has also been used to increase the range of indicating wattmeters and is very handy, since any degree of multiplication can be obtained.

J. F. Dostal, Denver, Col.

Testing Armatures for Open-Circuit Coils in Thomson Recording Wattmeter.

Use an incandescent lamp of approximately 16 candle power and 110 volts alternating current in series with a relay, and these in series with the coil being tested. If the circuit is complete the vibrations of the armature will indicate it. Saving in time and increased facility in making this test are considerable when a number of meters are in the repair department. This may be practiced by some companies, but I know it is not universally applied.

Wilmington City Electric Company.

Testing Direct Current Meters by Use of Electroplating Dynamo.

In testing direct current meters on various loads we have found it very satisfactory to use an electroplating dynamo, with capacity of 150 amperes and 5 volts. The terminals of this dynamo are short-circuited through the series coils of the meter, and a resistance in the shunt winding of the field governs the load. One side of the regular line is connected to one terminal of the dynamo, and the other is connected to the regular shunt connection on the meter, thus giving the required voltage across the shunt on the meter. The electroplating dynamo is run by a single-phase induction motor. By this method we are able to get any desired load up to 200 amperes by taking comparatively little load off the line.

Thomas S. Richardson,
Denver, Col.

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*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

PROCEEDINGS OF THE STREET RAILWAY CONVENTION.

The street railway men have good reason to be proud of their work at Philadelphia last week. The large attendance proved that all were interested in the reorganization scheme, and that in future there will be no "divisions in the ranks."

From the beginning of the week's programme there were no idle moments, as the papers presented by the various associations and the thorough manner in which they were discussed proved too attractive to the members to indulge in the many pleasures to be found on all sides.

The meeting of the American Mechanical and Railway Association extended over Monday and Tuesday. The delegates were welcomed by Mayor Weaver, who extended the freedom of the city, after which President Baker delivered his address, which was replete with good suggestions.

Papers were read as follows: "Power Distribution," by Mr. C. H. Hill; "The Power Station Load Factor as a Factor in the Cost of Power," by Mr. L. P. Crecellius; "Rail Joints," by Mr. F. G. Simmons; "The Power House," by Mr. Fred N. Bushnell, and "The Track Brake," by Mr. F. F. Bodler.

A long discussion followed the reading of each paper.

The following officers were unanimously elected:

President—H. H. Adams, Baltimore, Md.

First Vice-President—F. G. Simmons, Milwaukee, Wis.

Second Vice-President—J. S. Doyle, New York.

Third Vice-President—Paul Winsor, Boston, Mass.

Secretary and Treasurer—S. W. Mower, Detroit, Mich.

Executive Committee—W. S. Twining, Philadelphia; Fred N. Bushnell, Providence, R. I.; W. Boardman Read, New York, and A. D. Campbell, Seattle, Wash.

President Baker expressed, in a few well-chosen words, his thanks to the members for their co-operation during the term of his administration, after which the convention adjourned.

The American Street Railway Association.

Hon. W. Caryl Ely, president of the American Street Railway Association, called the 24th annual meeting to order at 11:15 last Wednesday morning.

In his address the president recounted the efforts that were made for reorganization, and spoke at length on the various questions that came up during the year in street railway circles, and the rapid advance in the electric railway art. He called the attention of the members to the agitation in favor of municipal ownership, "in order to attract their attention to the importance and desirability of investigation along certain lines intimately affecting the interests which the members represent."

The secretary presented the report of the executive committee, which report consisted of the minutes of the various meetings of the committee held during the past year on February 3, and 4, June 12 and 13, and September 26. On motion of Mr. W. B. Read, the report was accepted and ordered to be filed.

The secretary then presented his annual report. This report showed that the association in the past year had acquired 18 new members and had lost eight members; the total membership at present being 206 companies. The report of the treasurer showed the following financial transactions during the year: Receipts, $12,924.85; expenses, $6,192.65; balance on hand, $6,732.20.

The president stated that the next business would be the report of the committee on the reorganization of the association. As this was a very important matter it seemed proper that it should be presented in its entirety, so that all might understand thoroughly the great amount of work and thoughtful investigation that had been bestowed upon the question of reorganization.

The secretary then read the minutes of the various joint conferences between the representatives of the parent association and the allied organizations.

The president stated that the executive committee decided that it would be a good thing to secure the attendance at the meeting of Mr. Henry L. Doherty of the National Electric Light Association, who had been chiefly instrumental in bringing order out of chaos in the work of this association, and whose efforts had produced results which were very gratifying to the men in that branch of the business.

Mr. Doherty addressed the meeting and said that he had never realized so keenly the scope and perplexity of the street railway industry until faced with the responsibility of delivering an address upon the association work it demands; the wide scope of work not only dictated the necessity for wise planning of the individual company organization, but an equally wise and comprehensive organization of the association. The work in the street railway field required a knowledge of thermo-dynamics, mechanical engineering, electrical engineering, legal matters, materials, amusements, municipal engineering, and especially regarding paving, proper relations with State and municipal authorities, the newspapers and the general public. The association, to administer benefits to the fullest extent of its possibility, must be comprehensive and therefore probably complex and extensive.

At the conclusion of his remarks Mr. Doherty made several recommendations, based on many years' of experience in association work. He was tendered a vote of thanks.

The secretary then read the proposed constitution and by-laws of the "American Street and Interurban Association."

Several amendments were offered, but after a long discussion the new constitution and by-laws were adopted.

The committee on nominations of officers presented the following list of nominees:

For President—W. Caryl Ely, of Buffalo.

For First Vice-President—John I, Beggs, of Milwaukee.

For Second Vice-President—Calvin G. Goodrich, of Minneapolis.

For Third Vice-President—James F. Shaw, of Boston.

Under the new plan of organization the members of the executive committee are made up of the officers and the presidents of the allied organizations. President Ely announced the following members of the executive committee: Mr. H. H. Adams, of Baltimore, on behalf of the Mechanical Association; Mr. S. L. Rhodes, of Philadelphia, on behalf of the Claim Agents' Association, and Mr. Walter B. Brockway, on behalf of the Accountants' Association.

On motion, the report of the committee on nominations was accepted and the secretary authorized to cast the ballot of the association for the gentlemen named, which was accordingly done.

A committee of three was appointed on insurance and protection.

The first business of the meeting on Thursday morning was the reading of the paper on "Notes on the Design of Large

Gas Engines with Special Reference to Railway Work," by Mr. Arthur West, and the paper by Mr. J. R. Bibbins on "The Application of Gas Power to Electric Railway Service."

Both papers were discussed at the same time and claimed the attention of the members nearly all the forenoon.

At the afternoon session the papers on "The Single-Phase Railway System," by Mr. Charles F. Scott, and on "Electric Railway Equipment," by Mr. W. B. Potter, were read.

On motion of Mr. Harrington the following resolution was adopted: "That all regular standing committees of this association shall hereafter consist of three members."

Mr. Beggs, who was appointed chairman of the committee to prepare suitable resolutions with reference to the services of Mr. Thomas C. Penington as secretary and treasurer of the association, offered the following on behalf of the committee:

"Mr. Thomas C. Penington, who has been the secretary and treasurer of the American Street Railway Association for 10 years past, having severed his official relations because of the determination of the association to establish headquarters in the city of New York and the necessity of continuous attention to its affairs by the secretary; therefore, be it

"Resolved, that the American Street Railway Association does hereby record a minute of its earnest appreciation of Mr. Penington's fidelity to its interests, his devotion to its welfare and the eminently honest and satisfactory manner in which he has discharged the trusts imposed upon him.

"Mr. Penington's relations to the individual members of the American Street Railway Association have established friendships which will last through life, and they part with his services as an officer with the deepest regret and with a lasting appreciation of his kindly thought and attention to themselves and their friends during the many conventions which had been held under his able assistance."

The resolutions were unanimously adopted by a rising vote.

The president appointed as a committee on United States Mail Service the following named gentlemen: John I. Beggs, G. Tracy Rogers and P. F. Sullivan.

On motion of Mr. Bean the convention took a recess until Saturday afternoon (or until the last session of the Accountants' Association) when the convention adjourned sine die.

Street Railway Accountants' Association.

The ninth annual meeting of the Street Railway Accountants' Association was held September 28 and 29.

President W. G. Ross, in his annual address, carefully reviewed the discussion relative to the reorganization plans, and incorporated the remarks of himself and Mr. Henry at the joint conference held in New York last February.

Secretary White reported that 13 new members were received during the year and that the total membership is now 152.

On Friday morning the reports of committees and papers were taken up and discussed.

The usual resolutions of thanks were passed and the following named gentlemen were elected officers for the ensuing year:

President—Walter B. Brockway, Yonkers, N. Y.

First Vice-President—P. S. Young, Newark, N. J.

Second Vice-President—Robert N. Wallis, Fitchburg, Mass.

Third Vice-President—H. A. Ferrandau, New Orleans, La.

Secretary and Treasurer—Elmer M. White, Birmingham, Ala.

Executive Committee—W. G. Ross, Montreal, Can.; C. L. S. Tingley, Philadelphia, Pa.; F. Dabney, Seattle, Wash.; J. A. Pardee, Canandaigua, N. Y.

Advertising Committee Appointed.

President Blood, of the National Electric Light Association, has appointed Mr. Paul Spencer, of Philadelphia; Mr. John F. Gilchrist, of Chicago, and Mr. Joseph E. Montague, of Niagara Falls, as a committee to co-operate with the advertising committee of the American Association of Incandescent Lamp Manufacturers in the matter of assisting central stations in the adoption of advertising methods that will result in increased business. The lamp manufacturers' association made an offer to the National Electric Light Association, at the Denver meeting, of $10,000, to be expended for the above purpose, and the offer being accepted, this committee has been appointed to complete plans for the work.

A New Battery Company.

The Columbia Battery Company, located at State and Third streets, Milwaukee, Wis., is a recently organized concern for the purpose of manufacturing storage batteries for electric vehicles and electric launches, spark coil batteries, stationary lighting plants, electric bells, portable batteries, etc.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED SEPT. 26, 1905.

Electric Railways and Appliances.

800,246-247. Railway Switching and Signaling Apparatus. John D. Taylor, Buffalo, N. Y., assignor to the Taylor Signal Company. Filed Feb. 24, 1902, and Jan. 22, 1904.

800,294. Trolley-Pole and Stand. William W. Hallenbeck, Burville, Conn. Filed Jan. 12, 1905.

800,355. Fender. John C. G. Bradley, Brooklyn, N. Y. Filed April 13, 1905.

800,376. Train-Lighting System. Sigvald Krohn, Berlin, Germany, assignor to the General Electric Company. Filed Jan. 21, 1905.

800,584. Trolley-Wire Coupling. Edward M. Leslie, Cincinnati, O., assignor to the Kingsland Kay-Cook Manufacturing Company, St. Louis, Mo. Filed Nov. 20, 1903.

Electrical Machinery and Apparatus

800,204. Circuit-Breaker. Charles H. Brigham, New York City, and John C. Francis, Weehawken, N. J.; said Francis assignor to said Brigham. Filed March 19, 1904.

800,241. Electric Hoisting Mechanism. James B. Phillips, Portland, Me. Filed March 27, 1905.

800,315. Circuit-Interrupter. George P. McDonnell, St. Louis, Mo., assignor to the American Electric Company, East Orange, N. J. Original application filed May 10, 1902. Divided and this application filed Aug. 5, 1903.

800,375. Load-Meter. Elton J. King, Fort Wayne, Ind., assignor to the General Electric Company. Filed Sept. 6, 1902.

800,382. Dynamo-Electric Machine. John P. Mallett, Madison, Wis., assignor to the Northern Electrical Manufacturing Company. Filed May 10, 1901.

800,394. Electromagnetic Power-Generator. Joseph L. Potter and Reinhold A. Miller, Indianapolis, Ind. Filed Dec. 31, 1904.

800,603. Magnetic-Clutch Mechanism. Harry A. Williams, Akron, O., assignor to the Williams Electric Machine Company, same place. Filed Feb. 14, 1905.

800,609. Electric Cut-out Switch. Nathan W. Crandall, Hartford, Conn., assignor, by mesne assignments, to the Perkins Corporation, same place. Filed Nov. 19, 1904.

800,611. Device for Controlling Motors. Frederick B. Duncan, Madison, Wis., assignor to the Northern Electrical Manufacturing Company. Filed Dec. 30, 1901.

Telephones and Telephone Apparatus

800,160. Multiple Switchboard for Telephone Exchanges. Milo G. Kellogg, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed Nov. 30, 1891

800,161. Switchboard for Multiple Exchanges. Milo G. Kellogg, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Original application filed Dec. 31, 1882. Divided and this application filed Aug. 24, 1893.

800,534. Secret-Service System for Interconnecting Telephone Lines. Albert K. Andriano and Hermann Herbstritt, San Francisco, Cal., assignors, by mesne assignments, to the Direct Line General Telephone Company. Filed Jan. 26, 1901.

Miscellaneous.

800,154-155-156-157-158. Telegraphy. Francis W. Jones, New York City. Filed Feb. 7, March 11, March 31, April 3, April 27, 1905.

800,170. Means for Securing Electric Conductors. Carroll Potter, Philadelphia, Pa. Filed Sept. 16, 1902.

800,179. Electric Signaling System. Howell W. Souder, Tamaqua, Pa., assignor of one-half to W. D. Zehner, Lansford, Pa. Filed Jan. 27, 1905.

800,370. Magnetic Separator. Charles M. Green, Lynn, Mass., assignor to the General Electric Company. Filed Oct. 17, 1901.

800,472. Alarm System. Felix McGloin, New York City, assignor to the Automatic Fire Alarm Company. Filed Dec. 31, 1902.

800,489. Electrical Vibrating and Massaging Device. Louis E. Richmond and Charles J. Graham, Cleveland, O. Filed April 10, 1905.

800,515. Incandescent Electrical Furnace. Frank J. Tone, Niagara Falls, N. Y. Filed Dec. 7, 1904.

800,547. Signal System. William B. Bruce, Gallatin, Tenn., assignor of one-half to himself and one-half to Martin A. Ewing and Joseph H. Ewing, same place. Filed Jan. 16, 1905.

800,586. Electrical Rosette. James A. Mebane, South Boston, Va. Filed Aug. 2, 1904.

THE TELEPHONE WORLD.

Independent Telephone Merger.

J. J. Heim, president of the Kansas City, Mo., Home Telephone Company, one of the biggest concerns interested in the United States Telegraph & Telephone Company, announces that the new corporation will not only be a competitor of the Bell Telephone Company, but will compete with the Western Union and Postal Telegraph Companies for telegraph business. Late improvements, he says, will enable the company to use its wires for both purposes, reducing cost of operation and affording cheaper service. He expects the inauguration of this double service will bring about coalition between the Bell, the Western Union and the Postal companies and a rate war.

Telephone Rates Advance.

The Northwestern Telephone Exchange Company, which last spring entirely rebuilt its exchange in Winona, Minn., adopting the central energy system, announces an increase in the rates to be charged for service, this increase to be effective on the 1st of November. A corps of canvassers is making a house to house canvass of every residence in the county. The rates so far presented to those seen are practically the same as those charged by the Winona Telephone Company.

It is stated that the Albany, N. Y., Home Telephone Company will not merge with the telephone companies under the name of the United States Telephone Company. It proposes to retain its identity and to continue the policy pursued with such success so far in its career in that city.

A general overhauling and the placing of new equipment has recently been accomplished by the Independent Telephone Company of Union City, Ind.

The Citizens' Mutual Telephone Company of Paris, Ill., was lately formed by the consolidation of 14 Independent telephone systems in that State.

The Kansas City, Mo., Telephone Company is installing a telephone system in Argentine and will shortly have telephones in use there. A central energy system is being put in.

The Aurora, Kan., Telephone Company will build a line to Ames in the near future. The company now has connections with the Concordia Company.

The Bentonville, Ark., city council is considering an ordinance to control and restrict telephone companies.

The Fenton, Mich., Mutual Telephone Company lately received propositions from two telephone companies for the purchase of its system.

C. M. Hoover has been granted a telephone franchise in Calistoga, Cal.

The Waupaca, Wis., Independent Telephone Company has been granted a franchise.

The citizens of Fowler, Col., are about to form a mutual telephone company.

Company Refuses to Join the Trust.

One important Independent telephone system in Oklahoma, the Topeka & El Reno Telephone Company, has survived the consolidation of the Pioneer and the Missouri & Kansas Telephone Companies. The Topeka & El Reno Company practically controls all that portion of Oklahoma south of the Choctaw and west of the main line of the Rock Island Railroad. It began the building of telephone lines and exchanges in that territory prior to the opening of the Kiowa and Comanche country. The company is capitalized at $200,000, of which $140,000 is paid up. On a flat rate schedule of $2 for business and $1.50 for reidence telephones the company has prospered.

So long as the Pioneer Company was Independent there was a mutual agreement in which both companies were pledged not to invade each other's field. The compact was kept. Since the Pioneer purchased the property of the Missouri & Kansas in Oklahoma the Pioneer has made overtures to the Topeka & El Reno Company looking toward the control or purchase of the latter's holdings. All offers have been declined. The owners of the Topeka & El Reno Company have been careful to issue no bonds, and its stock is held in such a way that a rival company cannot get a controlling interest. If the Pioneer Company should begin building into Southwestern Oklahoma and paralleling the lines of the Topeka & El Reno Company the latter, according to a statement made lately by one of the officers, will begin building into that portion of Oklahoma now occupied by the Pioneer Company.

Long distance service was lately established between the Fort Worth Independent Telephone Company and the Waxahachie, Tex., exchange of the Ellis County Independent Telephone Company. Material is on the ground, and work is being pushed to connect the cities of Fort Worth, Gainesville, Sherman and Denison. Service between these cities is expected to be established within the next 90 days. Work is also in progress on a line from Fort Worth to Dallas. This line will probably be completed this month.

The directors of the Toledo, O., Home Telephone Company at a recent meeting decided to increase the wages of all its operators about 10 per cent. The increase was entirely voluntary and is greatly appreciated by the employes. The directors also declared the customary 1 per cent. quarterly dividend; the books closed October 1 and reopen October 10.

The Twin City Telephone Company has closed a deal for the Maple Leaf Telephone Company of Foley, Minn., and it is reported that a line will be run from Santiago, Sherburne County, to Foley, to connect with the local exchange. The purchase is taken as an evidence that the company contemplates invading territory tributary to St. Cloud.

The Northwestern Telephone Exchange Company has acquired a controlling interest in the Albert Lea, Minn., Telephone Company. This takes in the local exchange and for the present shuts out the Tri-State Telephone & Telegraph Company.

Will Perfect Telephone Invention.

Prof. L. I. Blake, head of the Department of Electrical Engineering at the University of Kansas in Lawrence, has been appointed chief engineer of the new submarine signal company which handles his invention for telephoning between ships, using the water as a medium. He made this discovery while a student in Berlin, and has been perfecting his invention. The system is already being used between American warships, and has recently been adopted by the German Government.

The Tri-State Telephone Company has rented offices in Brownsville, Pa., and will soon extend its county service from Uniontown and other parts of the county to Brownsville and other towns in the Monongahela Valley. Connection will be made at West Brownsville with the Union Telephone Company of California, Pa., which will give service at California, Coal Center and other lower river towns. The Tri-State has 12 exchanges in Fayette County, and about 3,000 subscribers.

At a recent meeting of the board of Kitsap County, Wash., commissioners, the Northwest Peninsula Telephone & Telegraph Company was granted the right to use 76 county roads and numerous streets and alleys in unincorporated towns in that county for the purpose of erecting poles, stretching wires and operating and maintaining a telephone and telegraph system thereon. The privilege is given for 50 years. The company now operates the telephone system in Port Orchard, Charleston and Bremerton, as well as to various other places in the county.

The Newcastle, Ark., Telephone Company was lately incorporated by J. L. McDougal, president, and W. J. Dillon, secretary. The purpose of the company is to construct a telephone line from Newcastle to Forrest City. The offices of the company are at the latter place. The capital stock is $1,700.

J. W. Callahan, who recently purchased the Bainbridge, Ga., Telephone Exchange, has begun the work of remodeling the entire system and in a few weeks Bainbridge will have a system the equal of those in most of the large Southern cities. Mr. Callahan invested $20,000 in the new equipment for the system and the work is being pushed as rapidly as possible. The drop flash light system will be used.

A report from Ardmore, I. T., states that the Sulphur telephone system has been sold by C. J. Webster and J. D. Kirby to W. N. Hayes, of Norman, Okla., and J. F. Rumley, of Chicago. The new owners have already taken charge and will make extensive improvements.

The Central Union Telephone Company of Richmond, Ind., has been refused permission to lay conduits in the streets until all the companies using wires are prepared to do the same thing.

A dozen farmers of Vera Cruz and Limeport, Pa., will construct a telephone line to Hosensack, where it will connect with the present line.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Banning, Minn.—An electric light plant and waterworks are to be established in this city in the near future.

Elk Rapids, Mich.—The council has granted a franchise to Arthur McMillan, of Toledo, O., for an electric lighting plant.

Hopkinsville, Ky.—John H. Bell, Jr., has secured a franchise to build and operate an electric light and power plant.

Humble, Tex.—The electric light and power plant at this place was lately destroyed by fire. The loss is estimated at $10,000.

Knoxville, Tenn.—The Consolidated Railway & Light Company of Philadelphia, Pa., may ask this city for a franchise to erect a gas and electric lighting plant here.

Little Chute, Wis.—The Kaukauna Electric Light Company has been granted a 10-year franchise to furnish commercial lights in this village.

Loudonville, O.—The electric light plant in this place, owned and operated by the city, was lately destroyed by fire.

Martin, Tenn.—The city officials will put in about $1,300 worth of improvements on the water and electric light plant.

Midland, Md.—J. C. Brydon, superintendent of the Consolidation Coal Company, will erect a plant at Ocean Mine No. 1 with power enough to supply light to this town and surrounding places.

Mooresville, N. C.—The citizens will vote October 10 on the issuance of $10,000 in bonds for the establishment of an electric light plant. Address the town clerk.

Port Washington, Wis.—The citizens have voted for the issuance of $75,000 bonds for the installation of an electric lighting and waterworks plant.

Rockford, Ill.—The stockholders of the Central Heat & Power Company have decided to double the lighting plant and a new 500 hp. engine and generator will be purchased.

South Bend, Wash.—Articles of incorporation of the Chinook Light, Power & Water Company, have been filed at the county auditor's office. The capital stock is $10,000. The incorporators are James T. Pollock and J. G. Kelly, of Portland, and Albion L. Gile, of Chinook.

Syracuse, N. Y.—The Auburn & Northern Construction Company of this city has been formed to construct railroads, electric light plants, etc. Its capital stock is $5,000, and incorporators, Harold C. Beatty, Harry J. Clark and Claude Constead, all of this city.

Theresa, N. Y.—The contract for the construction of the dam and the power house foundations for the municipal electric light plant of this city has been awarded to Contractor E. D. Bennet, of Pulaski.

West Brooklyn, Ill.—William Mink, of Paw Paw, expects to install an electric light plant here soon.

Woodstock, Ont.—By a vote of 42 to 165, the by-law to raise $50,000 to expend on improvements and extensions to the electric lighting and waterwork plants of this city was recently carried by property owners here. The adoption of the by-law means that new pumps, reservoirs and generators will be installed at a cost of $50,000.

STREET RAILWAYS.

Ardmore, I. T.—C. H. Barrett, of Kansas City, is in this city looking over the field in connection with the building of an electric line.

Athens, Ga.—It is entirely probable that the movement to build an electric railroad from this city to Carnesville will be revived and carried to completion at an early date.

Austin, Tex.—The charter of the Fort Worth & Mineral Wells Electric Railway Company of Fort Worth and Mineral Wells has been filed here. The capital stock is $250,000. This company will construct and operate an electric line between Fort Worth and Mineral Wells to carry passengers, express and freight. The incorporators are Cicero Smith, D. M. Howard, H. N. Frost, E. J. Waldron, Albert Stevenson, all of Palo Pinto County.

Bartlesville, I. T.—A company has been formed in this city to build and operate an electric line between this city and Dewey.

Bradford, Pa.—A new trolley line will be built from this city to Eldred. John C. Mills, a well known business man of Duke Center, is one of the projectors.

Durand, Mich.—J. D. Leland, cashier of the First National Bank and his associates, have accepted the franchise for an electric railroad franchise which was granted last February. It is announced that work on the line will be commenced at once.

Elgin, Ill.—Work on the new Elgin-Belvidere electric line is being pushed rapidly.

Helena, Ark.—A project to build a trolley line from this city to Brinkley is under consideration here.

Johnstown, Pa.—By recently securing charters at Harrisburg, the first steps were taken for the construction of four new electric street railways in Cambria County. Work is expected to start as soon as the contracts can be let.

Marysville, Cal.—The location survey for the electric railroad John Martin proposed to build to connect this city with Auburn, Grass Valley and Nevada City, is almost completed.

Norfolk, Neb.—Local capitalists contemplate building an electric line from this city to Emerson.

Rochester, N. Y.—The Holland-American Construction Company of this city was lately incorporated to construct railways, power and electric plants, canals and other public works. The capital is $1,000,000, and the directors are Newcomb Carlton, New York; George C. Smith, and Walter D. Uptegraff, Pittsburg; Joseph H. Lukach, London; John N. Beckley, Charles H. Palmer, J. George Kaelber, John F. Alden and George C. Buell, of this city.

Saginaw, Mich.—The Saginaw Southwestern Electric Railway Company has increased its capital from $50,000 to $100,000,

St Clairsville, O.—The citizens have been discussing the proposed electric railway from Bellaire to this city.

Steubenville, O.—The Steubenville & Wellsburg Traction Company has been incorporated with a capital of $10,000 by D. J. Sinclair and Joseph Carnahan.

Waterloo, Ia.—An interurban electric line between this city and Marshalltown is said to be a certainty.

POWER PLANTS.

Brandon, Man.—A syndicate composed of Canadian and American capitalists intend developing the water power on the Assiniboine River here. The intention is to erect a large power house and plant.

Harrisburg, Pa.—The board of directors of the Central Pennsylvania Traction Company at a meeting recently authorized the construction of a new power plant to cost from $200,000 to $250,000. The new plant will be erected upon the site of the present one. The question whether steam turbines and an alternating current with sub-stations or reciprocating engines with direct current, and ample feed wires, are to be adopted, is left for determination by a special committee of the board appointed to supervise the erection of the plant.

Reading, Pa.—The United Traction Company will build a $1,500,000 power plant along the Schuylkill River in this city.

Utica, N. Y.—Preliminary work has been started by the Hudson River Electric Power Company on the construction of a transmission line to convey electric power that will extend from the great power plant on the upper waters of the Hudson River to this city. When completed the line will be one of the longest in the East, extending a distance of nearly 100 miles. It is expected that it will be completed by the middle of next summer.

BIDS WANTED.

Fortress Monroe, Va.—Sealed proposals for furnishing and installing the fixtures for electric lighting in 30 sets, bachelor quarters, three double sets, officers' quarters, and the Post Exchange and Gymnasium Building here will be received until October 16. Bids should be marked as such on envelope or outside wrapper. Address R. H. C. Kellton, Quartermaster.

New York City.—Sealed bids or estimates will be received by C. B. J. Snyder, Superintendent of School Buildings of the Department of Education, corner of Park avenue and 59th street, until 11 A.M. on October 9. No. 1 for installing electric equipment in the addition to and alterations in Public School 27, on the southwest corner of Nelson and Hicks streets, Brooklyn. The time of completion is 60 working days. The amount of security required is $5,000. No. 2 for installing electric light wiring and fixtures in the fourth story of Boys' High School, Marcy avenue and Putnam avenue and Madison street, Brooklyn. The time of completion is 30 working days. The amount of security required is $800.

Washington, D. C.—Sealed proposals in duplicate will be received by the Department of the Interior at the office of Elliott Woods, superintendent of the United States Capitol Building and Grounds, until 2 o'clock P.M. November 8, for electric lighting fixtures for the House and Senate wings, United States Capitol Building. Specifications and general information will be furnished on application. The right is reserved to reject any or all bids or to accept parts or any or all bids, and to waive technicalities.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 16¼@16½c.; Lake 16¼@16½c.; casting, 16@16¼c.

It is stated that the Widener-Elkins Syndicate is buying Brooklyn Rapid Transit stock.

The Syracuse (N. Y.) Rapid Transit Company has increased its dividend rate from 4 to 5 per cent..

The stockholders of the Coney Island & Brooklyn Railroad Company will hold their annual meeting on October 16.

The New York & New Jersey Telephone Company has declared the regular quarterly dividend of 1½ per cent., payable October 14 to holders of record October 5.

An official of the Pennsylvania Electric Vehicle Company says: "Our sales for the current year have been very good and we are able to show a moderate improvement in earnings over those of last year."

The Hudson River Telephone Company of Albany, N. Y., has declared the regular quarterly dividend of 1½ per cent., payable October 14. Books close October 5 and reopen October 16.

It is current gossip that Kuhn, Loeb interests have recently bought 10,000 shares of Brooklyn Rapid Transit and that interests identified with the Morton Trust Company have also bought a like amount.

Plans are being formulated for the organization of the Rochester & Southern Electric Railway Company, with a capital stock of $5,000,000, to construct an electric line from Rochester to Elmira, N. Y.

For September Brooklyn Rapid Transit Company's gross earnings increased $5,200 per day over September last year, and gross earnings for the September 30 quarter increased $500,000 over last year.

A dispatch from New Haven, Conn., says the Consolidated Railway Company has ordered 57 cars of the latest type and 14 snow plows for the different divisions of the electric system. The new equipment will cost about $400,000.

The Rome and Oneida (N. Y.) Electric Railway Company was incorporated at Albany on Monday, with $350,000 capital stock, to construct a street surface electric railroad 13 miles long from Rome to Oneida. The directors are T. L. Hill and C. C. Goodwin, New York; E. F. Lally and G. V. Lally, Detroit.

Electric Company of America, Philadelphia, in eight months of this year shows a gain in net profits of $100,000 over last year. The company is now reported earning at the rate of nearly 12 per cent. on its stock and it pays 7 per cent. in dividends. Vice-President Catherwood says the outlook is excellent.

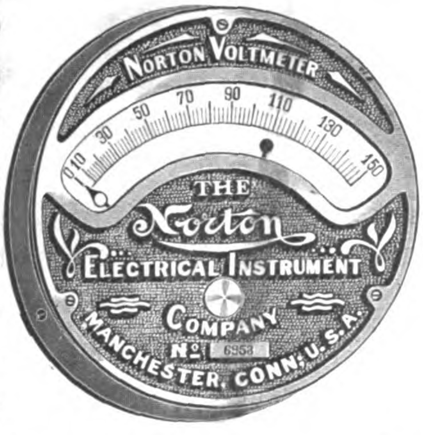
William S. Reed, representing a syndicate of capitalists, has agreed ts purchase the active property of the Chicago Electric Traction Company. The consideration is $200,000 in stock of the reorganized company and $650,000 cash. The road will be extended to Kankakee, Ill. When it is completed the syndicate may buy back the $200,000 stock for $100,000 cash.

A dispatch from Montreal, Canada, says the shareholders of the Mexican Light & Power Company, at a special meeting held at the Bank of Montreal Friday, ratified the plan of the board of directors to increase the capital stock of the company from $12,000,000 to $16,000,000. The additional $4,000,000 will be used to secure control of two of the largest lighting companies in Mexico.

ELECTRICAL STOCK QUOTATIONS.

Name.	Closing price Oct. 2
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	213
Manhattan Elevated Railway	165½
Metropolitan Street Railway	125¾
Metropolitan Securities	80¾
Ninth Avenue	197
Third Avenue	127
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	71¾
Brooklyn City Railway	239
New Orleans Railway	36½
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81¾
Philadelphia Traction	101
Union Traction	61⅝
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	16
do. do. do. pref	56
West End Street, com	99½
do. do. do pref	113½
Chicago.	
City Railway	192
North Chicago	83
Union Traction, com	13
do. do. pref.	44¾
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	18½
do. pref.	61
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	20½
do. do. pref.	24
Westinghouse, com	179½
do. pref.	195
General Electric	182⅜
Boston.	
Edison Electric Illuminating	253
General Electric	182⅜
Westinghouse Electric & Mfg., com	82½
do. do. do. pref.	93
Chicago.	
Chicago Edison	160
National Carbon, com	62½
do. do. pref.	115½
Philadelphia.	
Electric Company of America	11⅛
Electric Storage Battery, com	84½
do. do. do. pref.	84½
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	139
Western Telephone Company	16
New England Telephone Company	137
New York.	
American Telegraph & Cable Company	..
Commercial Cable Company	210½
Mexican Telephone Company	1
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93½
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Chicago Subway	56
Otis Elevator Company	60
Standard Underground Cable	..
Twin City Rapid Transit	118

NORTON SWITCHBOARD INSTRUMENTS.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10
30
50
70
90
110
130
150
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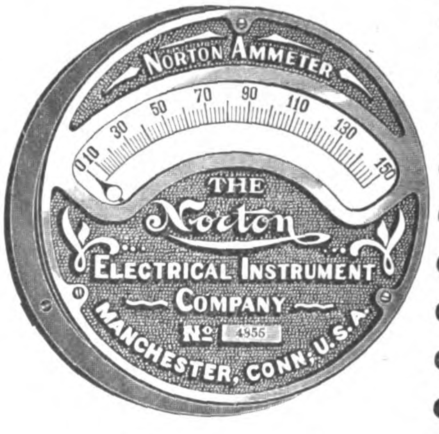
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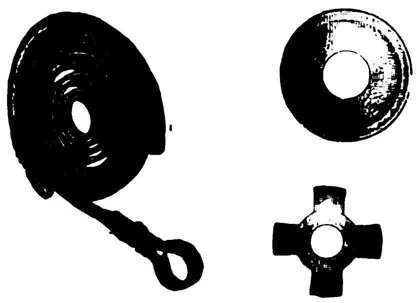
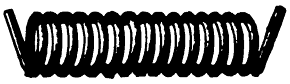


BRISTOL, CONN., U. S. A.,



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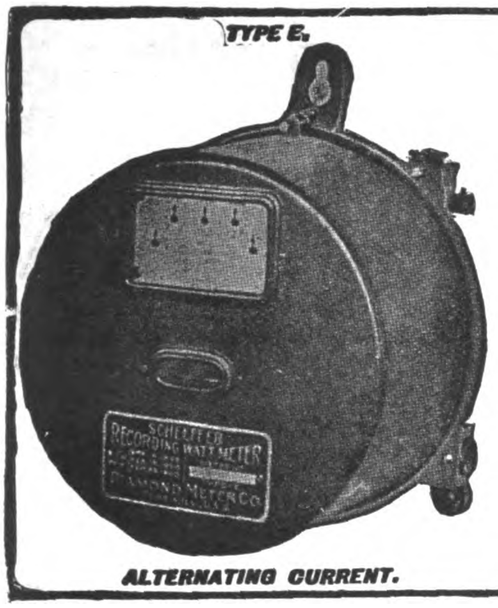
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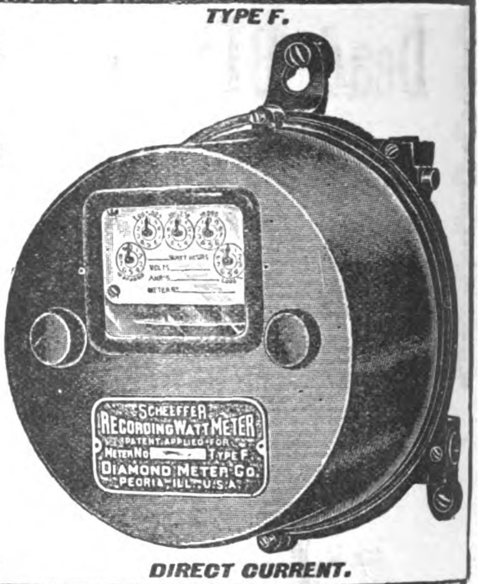
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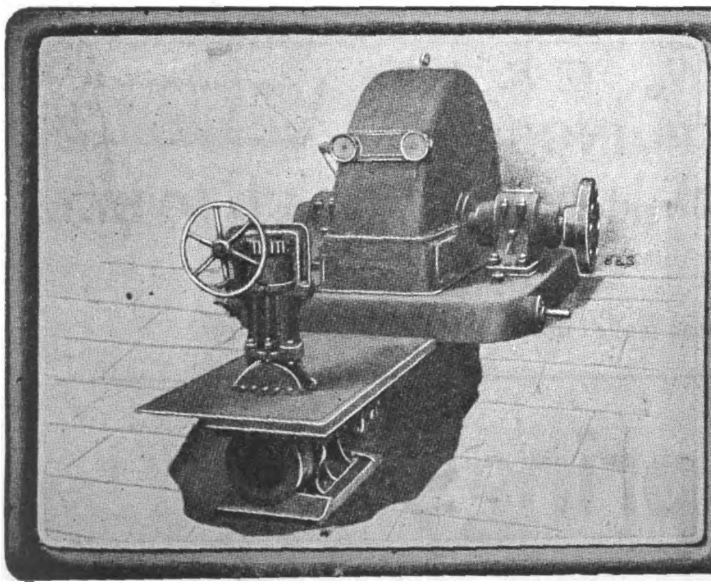

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ELECTRICITY.

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EDITORIAL NOTES.

German and American Electrical Workers.

The foreign worker arriving at American shores is struck by the magnanimous salaries paid to those of his class. He is frequently appalled, however, by the cost of the good things he is accustomed to at home. This applies particularly to the German engineer, draughtsman or artisan. It applies to some extent to the workers of other nationalities—the Austrian, French, Italian or English. But the case usually presented, is that of the German and American. The question frequently arising is that of high wages and a higher cost of living. To the German worker, full of the traditions of the old country, the living wage is an all important issue. If it is not forthcoming he emigrates; in this respect the English worker differs. Emigration to him consists only in leaving England for another colony over which her flag waves. English workmen do not seek American shores in either the numbers or with the same spirit as the German. But the weightier matter, rising in greater and greater prominence, irrespective of the national origin of those working, is that of the returns for labor and the cost of living. A report reaching this country from Berlin, states that the employers of the Allgemeine and Siemens-Halske Companies have locked out about 10,000 of their employes. This lockout affects the cable works of the Allgemeine Company on the Upper Spree, and the dynamo works of the Siemens-Halske Company at Charlottenburg. Trouble between the great electrical companies of Berlin and their employes has been brewing for some time. The workmen in several departments of the two chief companies have been the leaders in this move. The men say the cost of living has risen so high, owing to the high price of wheat and other articles, that their wages are not sufficient. At least 60,000 men are employed by electrical companies in Berlin, and their future is as much related to the outcome of this agitation as the active parties engaged. A German electric lockout, conducted on this basis, offers room for a comparison. While the discussion of economic questions is not the purpose of these columns, still the consideration of the welfare of our own electrical workers is a matter of vital importance. The Germans, it seems, with their thrifty mode of life, are actually appealing for more necessities. They cannot live with what they now receive. Are the prices paid for German machinery too low, or is the German too willing to work for a scanty stipend? If this last is the case, combination will effect great things. If the former, the price of machinery must be raised. In America the wages paid bear a distinct relationship to the American way of living, the selling price of the generator or other form of electrical apparatus, and the rainy day, always held in prospect. Reinforced, as the ranks of the German workmen are by the peasant element from the interior and the South of Germany, their standards of living are lower than our own. If they demand more of their employers, it is because they cannot subsist on what they get. Their wages border on the line between necessity and want. It seems that the electrical industries of Germany are in a flourishing condition. For this reason, the plea of the electrical workers is probably more than a delegate's ambition. The electrical worker in this country is by far better off than his brethren abroad. No wonder the German artisan finds a haven of refuge here from the pressure of living he experiences in his own fatherland?

* * *

The Highest Speed of Electric Trains. The theoretical speed of a certain class of motors with no load is infinite. The series wound motor represents this class, and is the type employed to run electric cars for street railway service or heavy traction. Within the city limits speed is regulated by ordinance not to exceed a certain figure, but in the case of a traction system, devoted to passenger and freight service, operating on lines stretching away to distant cities, the conditions are different. It has always been the aim of railroad companies to increase the speed as far as was consistent with safety. All roads preserving a good time schedule and running fast trains have been best patronized by the public. The question, therefore, of the highest speed of electric trains now practical is deeply interesting.

The series motor, when unloaded, reaches a terrific rate of speed. The heavier this machine in rating, in comparison with the weight of the car and trucks, the more nearly is the condition approached of a light load. In other words, though a speed of 80 or 90 miles an hour is given as the rate at which the New York Central trains will run when the electric system is completed, it must be understood that with more powerful motors the relationship of load would thus be reduced and in consequence the speed greatly increased. Speeds of 100 or even 150 miles an hour are perfectly practical at present if a good roadbed and a reliable lubrication are assured things.

* * *

Electrical Design and Art Standards. Observation will quickly remind one of the transformation occurring in the different departments of electrical engineering. The arc lamp, incandescent lamp, generator, switches, and other appliances of electric lighting, have passed through a certain experimental and probationary period. They are no longer the crude looking, clumsy devices originally placed upon the market by early inventors. As an instance of this transformation, the arc lamp, whose weight in the beginning of its history as a street light was so great that a heavy support and hoisting apparatus was necessary to handle it, is now, under the influence of a growing sense of art, embellished and ornamented to a high degree. It is small, light in weight and handsome in appearance. Interior lighting is made much more successful and far more attractive by its use. The incandescent lamp has been reduced in size as well. It is fitted into artistic chandeliers and fixtures. Our ferry boats are brilliantly illuminated by its light, and the more modern of them, plying across the Hudson and the Bay, represent high standards of interior decoration in the fixtures to which these lamps are attached. The generators and motors are also polished and painted to please the eye, and the external form given lines dictated by the same sentiment. The first experimental stage of reduction to practice has been safely passed. The second, a recognition of the æsthetic demand, is rapidly forging to the front.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

A monument to Zenobe Theophile Gramme was unveiled at Liege, Belgium, on October 2.

◆

The International Brotherhood of Electrical Workers has unanimously resolved upon a national strike against the New York Electrical Contractors' Association.

◆

The American Society of Civil Engineers is considering the advisability of establishing local sections in various cities.

◆

The Pennsylvania Railroad Company is considering the operation of one of its lines by electricity between its ferry terminal in Camden, N. J., and its electric line in Atlantic City.

◆

President Fish of the American Telephone Company (Bell), who recently returned from a trip on the Continent, makes this statement: "I think, generally speaking, it may be said that the market for telephone securities is gradually broadening." The Independents arrived at the same conclusion some time ago, and that is one of the reasons why they are now struggling to get into New York.

◆

Although the impression has been general that the mileage of electric vehicles is restricted to 25 or 30 miles on one charge of the battery, this idea is fading away with the improvements that are being made over the machines of a few years ago. A rather interesting test in this connection was conducted at Indianapolis recently with a Pope-Waverly road wagon. It was fitted with a 30-cell, nine-plate battery and new cord tires. It was run at intervals without charging from Saturday noon until Tuesday afternoon, and during that time covered 80½ miles, at least one-third of which was over country roads that included many hills. The performance is taken to show the general advancement of the electric, which, together with its characteristic adaptability and perfect safety, is bringing to it a strong following.

◆

A new record in receiving wireless messages has been made by the Government wireless telegraph plant at the torpedo station at Newport. Using a German system, 18 words a minute were received clearly and accurately from Cape Henry, 350 miles; Washington, 325 miles; Philadelphia, 250 miles; Portsmouth, N. H., 150 miles, and several other points where the Government has wireless stations.

◆

The eighth annual convention of the Kansas Gas, Water, Electric Light and Street Railway Association will be held at Kansas City, Kan., at the Mercantile Club House, on October 13 and 14. Mr. R. C. Johnson is president and Mr. I. D. Nicholson secretary.

◆

Upon completion of the Pennsylvania Railroad Company's $60,000,000 tunnel terminal system in New York, the purpose is to run a majority of the electric suburban trains of the Long Island Railroad through the Subway system of this city. To this end it is said a tentative understanding has been reached between officers of the Pennsylvania Railroad and the Interborough Rapid Transit Company.

◆

William D. Mahon, president of the Amalgamated Association of Street and Electric Railway Employes, has issued an address to the members of his order urging arbitration instead of strikes. The address says: "We must bear in mind that in our position as street and electric railway employes we are servants of the public as well as of the company, and that the public is entitled to a certain amount of consideration at our hands. The only means we have of carrying out such a policy is by arbitration, for by submitting our disputes to a disinterested board of arbitration we are able to reach a satisfactory adjustment without having inconvenienced the public or interfered with travel." That's the kind of talk all the labor leaders should indulge in.

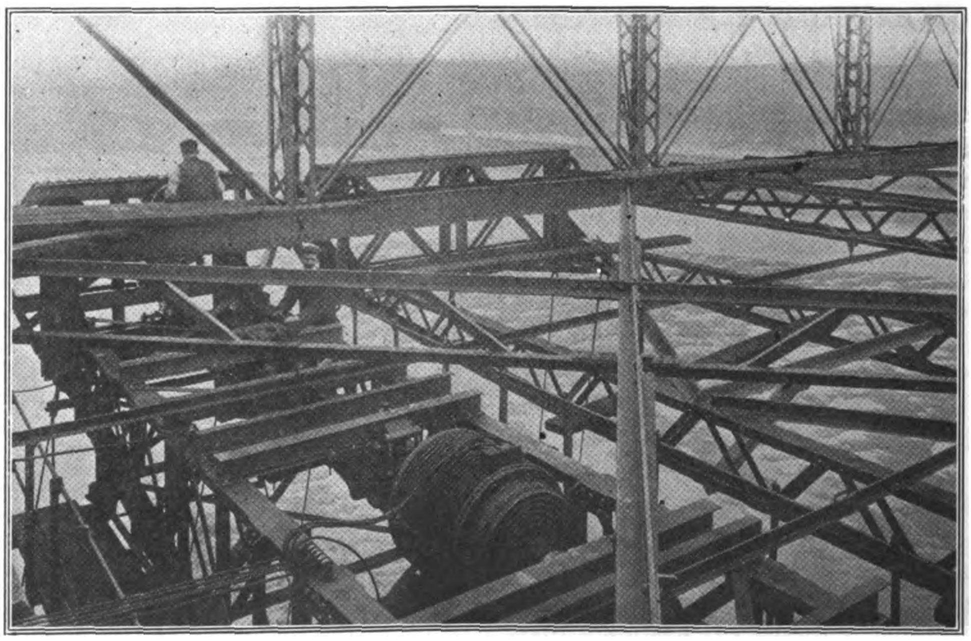
BRIDGES ELECTRICALLY OPERATED IN ENGLAND.

(From our London Correspondent.)

There are not many examples in England of the application of electrical power in the operation of bridges. The first swing bridges to be so worked were the two over the River Weaver at Northwich in Cheshire. These each weigh about 300 tons, of which about 250 tons are carried by the buoyancy of a water-tight pontoon, the remainder being borne on 76 live rollers. The roller is carried on seven cast-iron screw piles. To neutralize the effect of variation of the water level the pontoon is entirely submerged; it is divided into compartments for greater safety. The operations of withdrawing the wedges at each end, and turning the bridge, are controlled from a single cabin. Here there are three large rheostatic controllers, one for each wedge motor, and one for the turning gear. Mather & Platt ammeters and B.T.-H. circuit breakers are provided. The 5 hp. wedge motors are located under the bridge; the wedges are drawn and returned by a right and left-handed screw driven through bevel gear. The 20 hp. turning motor drives, through double helical gear, a drum upon which is wound a 1½ inch steel rope. The ends of the rope pass round, and are attached to a drum fixed to, and concentric with, the axis of the bridge. The motor shaft has a ball thrust bearing, and the turning drum is also carried on balls. A powerful band brake enables the operator to check the movement of the bridge. Two 4 hp. motors are used for working the gates. These motors are controlled from small switch pillars standing by the side of the roadway.

View of Transporter Bridge Connecting Widnes and Runcorn.

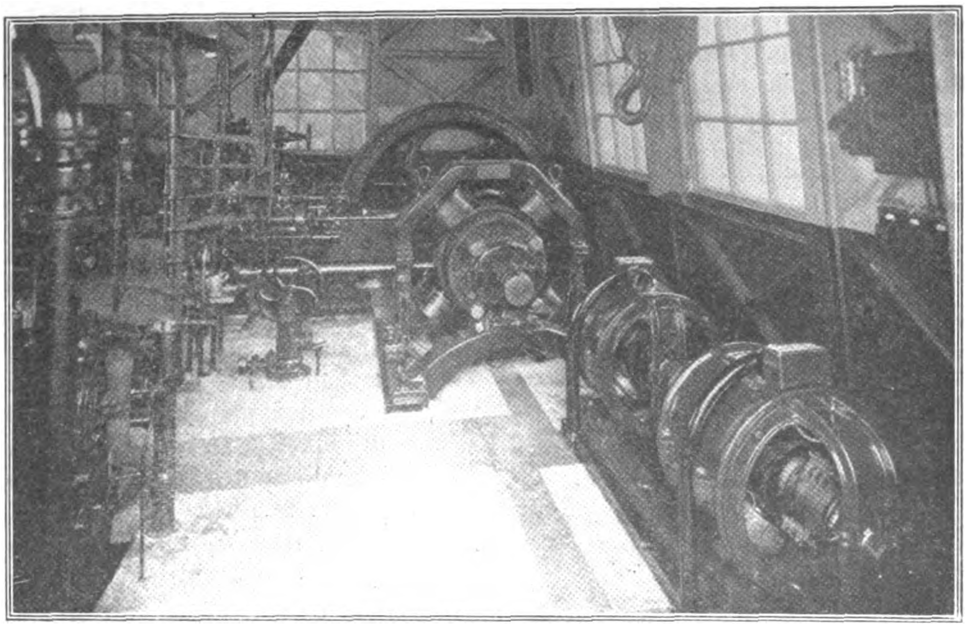
The engineers for the Weaver bridges (Messrs. Mather & Platt, Ltd., of Manchester), who have specialized in this particular line of late, have also recently electrically equipped a rolling bascule bridge at Barking. Experience obtained in these directions was of great assistance in electrically operating transporter bridges, designed on similar lines to that at Rouen. The 1,000 ft. span Transporter bridge over the River Mersey, between Widnes and Runcorn, is the most recently completed example. It has been erected to the design of Mr. John J. Webster, M. Inst. C. E. of Westminster, and the electrical equipment was carried out to the joint design of that gentleman and Dr. Edward Hopkinson. Accompanying this article we show several views illustrating the bridge, its structure and the electrical plant.



The Widnes and Runcorn Bridge, Showing Equipment and Construction.

The engine house is erected within the left hand tower on the Widnes side of the river, and contains the whole generating plant, which comprises two Crossley gas engines of 75 B.H.P. each; the cylinders are 16 inches in diameter, with a stroke of 21 inches, the speed being 210 revolutions per minute. The gas is supplied from the Widnes town gas mains. The engines are fitted with the usual silencers and water-cooling pipes, the water supply being obtained from a large tank fixed at the top of the engine house. A Mather & Platt multipolar dynamo of 48 kw. capacity and capable of giving a continuous output of 90 amperes at a pressure of 525 volts when running at 210 revolutions per minute is direct coupled to each engine. The engine house also contains a booster for boosting the pressure when charging the accumulator, and also for maintaining the voltage on the line and equalizing the load on the generating dynamos. The accumulator is placed in a room above the engine room, and consists of 245 chloride cells, of a capacity of 90 amperes for one hour. The cells are mounted on insulators carried on suitable stands. In the corner of the engine room is the switchboard arranged with three panels; one for the dynamos, with the necessary main and regulating switches and measuring instruments; the second for the battery and booster, and the third for the feeding and lighting circuits.

From the switchboard two main supply cables are led up by the tower and across on to the main girders of the bridge, where they are attached to two overhead

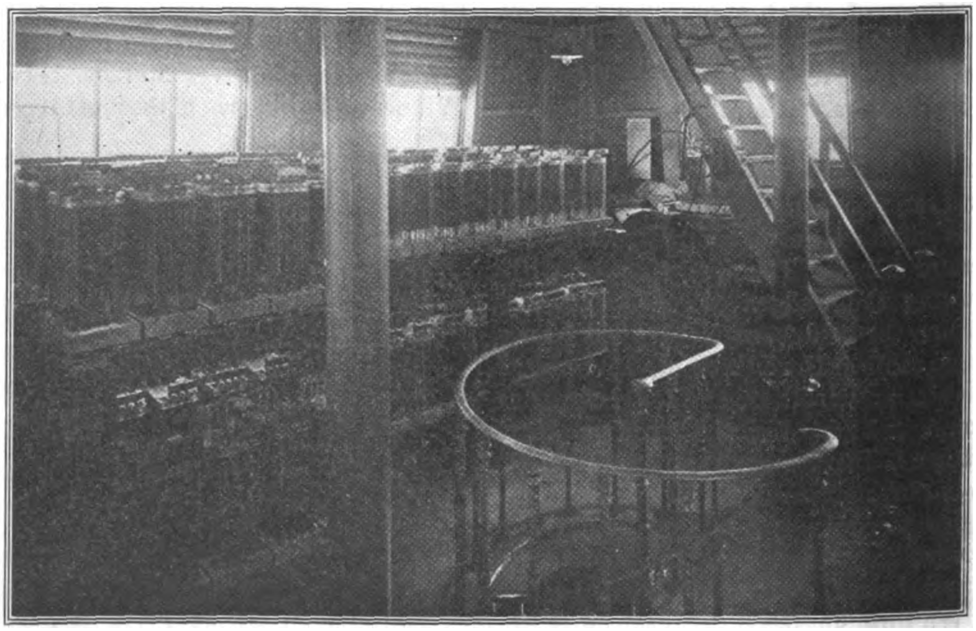


Engine House of the Widnes and Runcorn Bridge.

T-shaped conductors, which are carried by insulators below the cross girders of the bridge, and from which the current is collected by trolley arms, and thence passes down to the controlling apparatus in the driver's cabin, placed on the top of the transporter car. The regulating apparatus consists of a circular type controller by means of which the starting, regulating and stopping of the motors on the traveling trolleys is effected. From the controller cabin the wires are led straight up to the motors fixed on cross girders connecting the pair of trolleys, which run on each of the continuous main girders of the bridge. The motors are of the Mather & Platt steel clad entirely inclosed type, to develop 35 B.H.P. each with a 500 volt current; they drive by means of gearing and shafts the two driving wheels of the trolleys, and are arranged also to act as brakes for stopping the car. The control cabin also contains a small switchboard with the requisite switches and instruments for the information of the driver.

The bridge is lighted electrically throughout, by means of five arc lamps in each of the four lanterns at the summits of the towers; incandescent lamps in standards on the approach roads on either side of the river, as well as the necessary lights on the car itself, and in the waiting rooms and offices on the landing stages.

Another interesting example of an electrically worked transporter bridge is that which has been constructing for some time, and is now very near to completion, spanning the River Usk, and connecting the two parts of the borough of Newport (Mon.), in Wales. The principle of electrical operation is different from that obtaining in the cross-Mersey bridge above described, for the steel wire ropes are wound on a drum which is worked by motors placed on the western shore. The trolley for the Widnes-Runcorn bridge is about 77 feet in length, with 16 running wheels each side, it carries a 55 foot transporter car; the Newport traveling frame is 104 feet long, with 60 wheels in all, and its transporter car is 33 feet long. The Newport bridge has been described as really a suspension bridge carrying on its underside lines of rails, on which will run a truck from which is hung a platform or car at the level of the brakes of the river. It is said that the car with its load will weigh 117 tons; special attention has had to be devoted to the possibility of high winds being encountered.



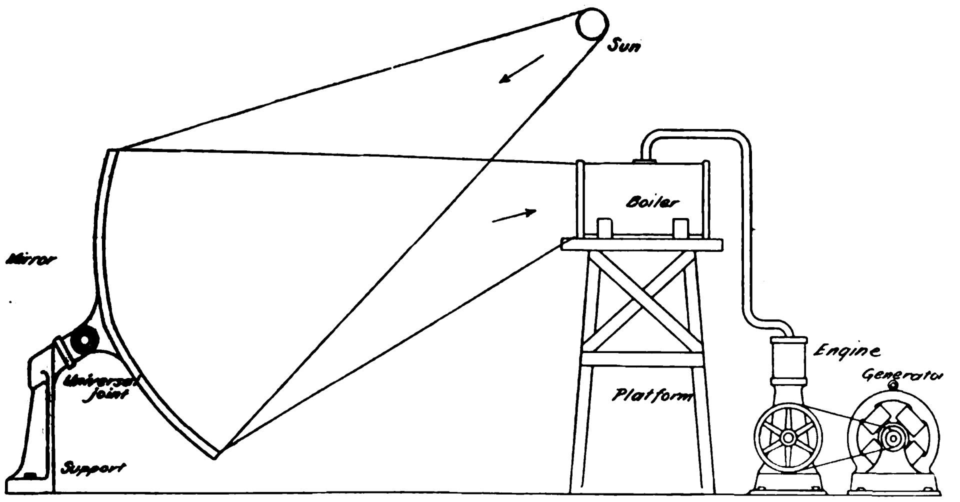
Battery Room Above Engine Room of the Widnes and Runcorn Bridge.

LIGHT, HEAT AND POWER PRINCIPLES.—III.

BY NEWTON HARRISON, E. E.

Power from the Sun.—Although it is not a difficult proposition to prove that all forms of energy known originated in the sun, as far as the solar system itself is concerned, it is of great interest to observe the trend of the efforts made to utilize the sun's rays directly. Ericsson was among the first to advance the idea of the sun motor. By this is meant an engine, so constructed that the action of the sun's rays will heat a steam generating section and thus develop power and rotation. In fact the engine is simply a specially constructed steam engine, the principal part, the boiler in this instance, representing the focus of such of the sun's rays as are gathered up by specially constructed mirrors. It is obvious that the amount of heat transmitted by the sun reaches into figures almost beyond computation. By this is meant the heat energy, not the light, though both can be categoried on this basis. Light is the one item which, so far, cannot be either transformed or stored, as may other forms of energy. The only illustration of this action widely known is that of the plant in manufacturing chlorophyll by the action of light. In this respect because coal is a product of vegetation and vegetation a consequence of light energy being absorbed, coal itself becomes in this sense stored sunlight. The action in this case is one in which light acts as an agent in producing changes in the chemical constitution of vegetal matter.

The utilization of the sun's heat directly by means of concave mirrors, which focus the heat rays, which direct them upon a boiler, which generates steam, which develops rotation by means of an engine, which gives power for driving a dynamo, and which finally permits the storage of electrical as chemical energy in storage batteries, is an illustration of the different channels through which energy can pass before emerging in the form in which it is to be finally utilized. In this instance, at night, the current could be employed for lighting, and thus a certain percentage of the original ether waves again transformed into light and heat.



Method of Utilizing the Sun's Heat for Generating Electricity.

Estimates have been given of the amount of energy radiated by the sun upon a square foot or yard of the earth's surface. It is unnecessary to state that the light is of a brightness unsurpassed by the most brilliant sources of illumination at present in service. Depending upon the position of the sun's rays, whether at early morning, noon or later, the degree of heat and consequently the energy available at a given location would vary. At the equator it might rise to ¼, ½, 1 or more horse power per square yard. At the Tropics of Cancer or Capricorn it would be less, until the temperature zones were reached, where it would be fairly uniform. The great Sahara Desert represents in this respect a source of power as difficult to measure as the tidal or wave forces of the world. At the low estimate of ¼ horse power in heat energy per square yard for 5 hours a day, this desert would yield from a strip 100 miles in length by 100 miles wide the following:

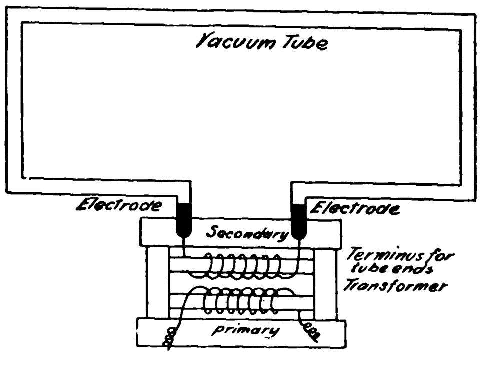
100 miles = 5,280 ft. × 100 = 528,000 ft.
100 miles × 100 miles = 528,000 × 528,000 = 278,784,000,000 sq. ft.
1 sq. yard = 3 × 3 = 9 sq. ft.
278,784,000,000 ÷ 9 = 30,976,000,000 sq. yards.
At ¼ hp. per sq. yard 30,976,000,000 sq. yards produce ¼ × 30,976,000,000 = 7,744,000,000 hp.

For 5 hours the output would be 38,720,000,000 horse power hours.

Vacuum Tube Lighting—A form of lighting which offers some relief from existing methods, in that no actual incandescence of solid matter takes place, is found in the vacuum tube. The usual method of producing light, is to heat to whiteness a certain body of material, usually carbon, and from the radiation thus secured obtain enough light for practical purposes. In burning ordinary illuminating gas, a flame consisting of millions of carbon molecules heated to comparative whiteness, creates the illumination so widely employed. In the use of acetylene, the gas is also capable of producing an incandescent screen of white hot material; but a whiter light due to a higher temperature results. In the Welsbach burner, the heat of the flame is increased by permitting air to enter at the base, and produce a Bunsen flame, which plays upon a screen of rare oxide composing the mantle.

The incandescent lamp is an obvious case of the electrical energy producing heat directly in the filament. The principle, that in proportion to the resistance of the conductor, however good or bad, the energy is degraded into heat, holds true here in a striking manner. The effort is made to degrade all of the energy, the carbon filament by its resistance can transform into heat. From the heat thus produced, the amount of light, variously rated as 16 or 32 candle power, as a usual thing results. But the carbon is the form of solid matter upon which the current operates, heating it, as in the gas or acetylene flame, and secondarily producing light. The arc lamp is a similar instance of where the arc formed between the carbon terminals is composed of carbon molecules, which permit the current to jump across, and in so doing are so raised in temperature that the characteristic dazzling brightness appears. The screen in this case is a mass of carbon particles, probably molecular, heated to vivid incandescence, as in the previous cases referred to. The vacuum tube system of lighting, as now in evidence, consists of a long glass tube of two or three inches diameter, and 10, 20, or even more than 50 feet in length. This tube contains either a partial vacuum or a gas of secret nature, but capable of transmitting the energy imparted to it from end to end. The tube is supplied at both ends with electrodes, which impart the electricity to the gas or remaining air contained within. The ensuing process is of a different character to those outlined. The gas molecules become the carriers of the energy, and being charged act in every respect like other light bodies affected by static influences. The individual charges are sufficient to cause extreme repulsion and agitation among the molecules. They move backward and forward with extreme rapidity, colliding frequently. The extent of the collisions is in some respects a measure of the amount of light produced. Thus, the entire problem of vacuum tube lighting resolves itself down to a case where the original energy is utilized to create free molecular motion over a large path, with the average result that a great number of impacts take place between the carriers. The greater the number of moving molecules, and the faster they move, the greater the number of impacts and the greater the degree of illumination resulting.

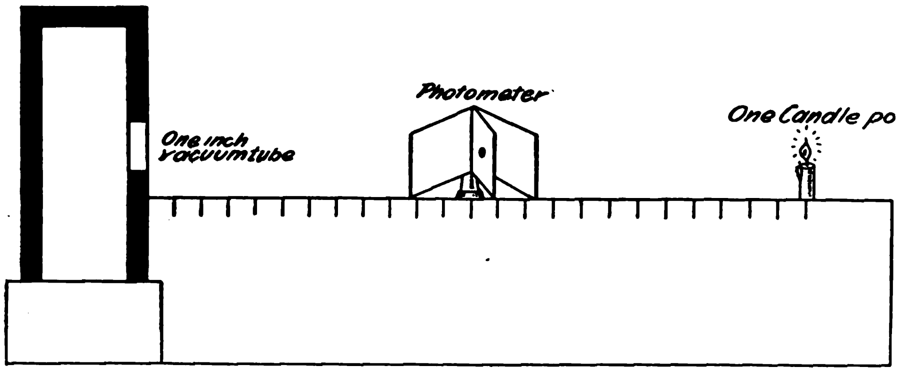
This device is placed around a room, at about the meeting of the wall and ceiling, as one long glass tube, whose two ends enter a box communicating with the source of electric current. The current used is alternating, and is transformed until it reaches a high potential. It is obvious that the potential in this case must bear a direct relationship to the length of the tube. The longer the vacuum tube, the greater the pressure re-



General Principle of Vacuum Tube Lighting, Showing Use of Transformer.

quired to cause a uniform degree of illumination to appear.

Amount of Light per Inch of Tube.—The system calls for the use of a photometer, by means which light measurements are taken of any inch length of the tube. This device gives such results that the failure of the tube to render a normal amount of light is readily detected. In this system a method of joining the glass has been developed, by which it may be lengthened, reduced or repaired with facility. Another feature is one by which it can be exhausted or readily resupplied with the gaseous constituents necessary for the production of light. In all systems developed on these lines the integrity of the vacuum is of first importance. Unless it is preserved the candle power will vary with every change of this kind. At the end of a given length of run the advantages consist of the following: First, it is not necessary to reinstall new lighting apparatus to replace the old; second, it is claimed that the rehabilitation of the system is not a matter of great expense; third, the form of illumination is such that the various degrees of light are admirably mixed in the proportions which insure an agreeable light impression; fourth, because no actual wear takes place of any particular part, the tube may be readily and permanently adapted to the walls of the room, hall, theater or place of worship. The cost of the first installation is fixed; changes in the system would only amount to a new distribution of the light; fifth, the light within the tube is not of an intensely brilliant character, but subdued and non-irritating. It deserves the name given it—artificial daylight.



Method of Getting Candle Power of one inch of Vacuum Tube.

Efficiency.—The power consumed is not in excess of that required for the incandescent lamp system. Per unit of light, the watts required range from 3 to 4, that is, per candle power. The incandescence of the gas particles within the tube, brought about by their motion, may eventually reach a point, by the use of a particular gas, where very little power will excite intense agitation. The elimination of heat is accomplished more thoroughly in this system than in any other in vogue. Heatless light, if properly produced, would mean an economic revolution. A gas jet gives about 1 per cent. or less return in light from the gas consumed. This means a waste of over 99 per cent. of the gas, as far as this object is concerned. A 16 cp. jet taking 5 cubic feet per hour would therefore give 99 × 16 = 1,584 cp. at an efficiency of 100 per cent. Light is therefore wasted to an immense degree, because the present methods are primarily heat instead of light-producing. Comparing the various sources of light gives the following:

COMMON ILLUMINANTS.

First—Torch of resinous wood as a source of illumination, approximately 1 hp. per 16 cp.

Second—Candle made of wax such as paraffin, approximately $\frac{3}{4}$ hp. per 16 cp.

Third—Kerosene oil lamp, approximately $\frac{5}{8}$ hp. per 16 cp.

Fourth—Lamp using illuminating gas, approximately $\frac{1}{2}$ hp. per 16 cp.

Fifth—Welsbach mantle, approximately $\frac{3}{8}$ hp. per 16 cp.

ELECTRICITY.

Sixth—Incandescent lamp, approximately $\frac{1}{10}$ hp. per 16 cp.

Seventh—Vacuum tube lighting, approximately $\frac{1}{10}$ hp per 16 cp.

Eighth—Arc lamps, approximately $\frac{1}{100}$ hp. per 16 cp.

The above figures are arbitrary, but they present a relative view of the amounts of energy consumed to give light. The amount of heat in the carbon when oxidized, considered as a definite amount of energy, covers the first five cases. Those that follow use electricity; if the power price paid for this is estimated from the fuel itself, then the energy consumed in producing electric light would be large in spite of the use of improved and expensive machinery.

TWO LABOR-SAVING DEVICES.

BY W. H. WAKEMAN.

Fig. 1 represents a device for unloading and storing fine coal, coal dust, etc., which has proved very successful in practice. A belt is run over four pulleys, as shown, and power for driving it at a high speed is supplied by an electric motor, located in a small building to protect it from flying pieces of coal. There are no cleats or buckets on this belt, yet the material is carried swiftly upward, partly by the strong draft of air created by the belt moving so rapidly through an inclosed space. The upper pulley is about 40 feet above the ground, in order to permit of unloading several car loads of coal without trimming it.

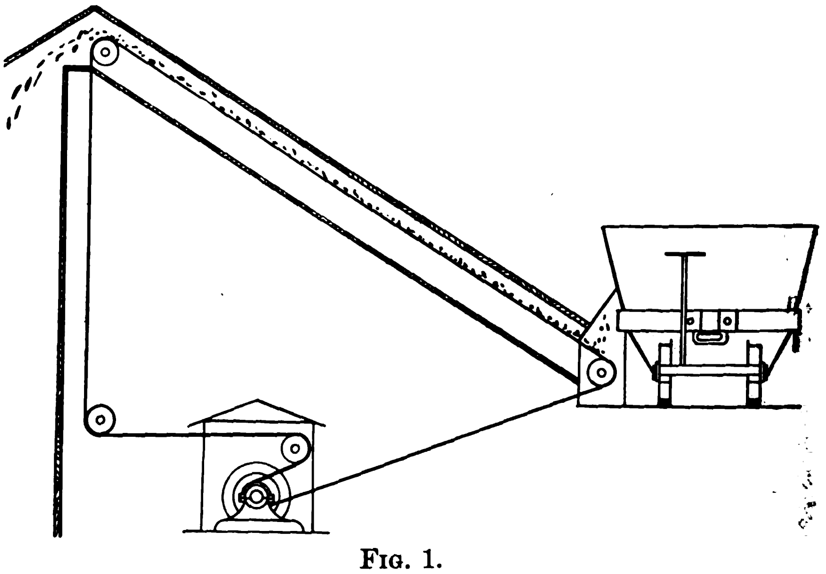


Fig. 1.

Fig. 2 represents a device invented by a working engineer for the purpose of unloading oats and delivering them to his employer's barn. As many horses are used by this firm the work of unloading a car load of oats frequently was quite an item of expense. The barn is several rods distant from the machinery used in its regular business, therefore it was not considered practical to use any device requiring belting and shafting, but use of electric motors in various parts of the works suggested the idea of using one for this purpose, as it was a very simple matter to run wires to and from any point desired.

The operation is as follows: A car filled with oats is run into the yard on a private track and placed so that when a small opening is made at the bottom of a temporary door that is provided for such places oats will flow out into a hopper, as shown. They are thus conducted to a spiral conveyor 2, which carries them under a driveway to the bin 3. A bucket elevator next raises them to another bin 4, out of which they are taken by another spiral conveyor 5, and delivered to a large bin in the upper story of a storehouse where they are kept until wanted.

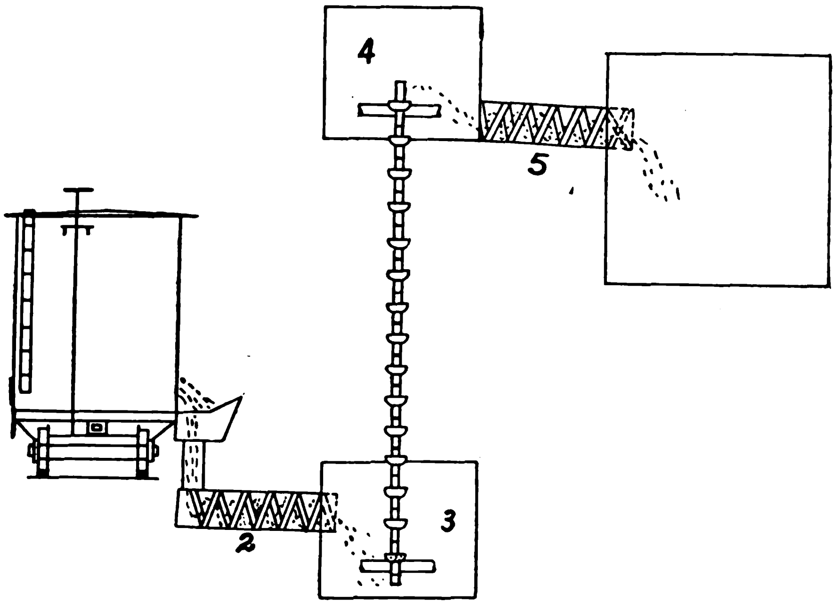


FIG. 2.

Fig. 3 is a side view of the bucket elevator and the motor which drives it. The two spiral conveyors are connected to and driven by this elevator, which is inclosed by means of a wooden housing that prevents the oats from being scattered.

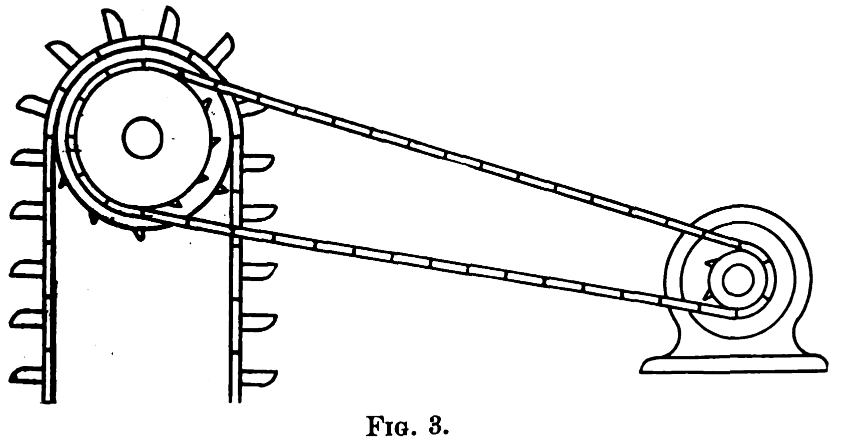


FIG. 3.

The driving wheel on the motor is of the sprocket type, with a chain to fit it, instead of a smooth pulley and belt. This gives a positive motion to the elevator, and as the whole apparatus except the motor, is out of doors, a chain is more suitable than a belt.

Both devices mentioned were installed to eliminate hand labor as far as possible, and in both cases they save about 90 per cent. of the expense formerly necessary to handle the material.

Cars containing these oats are taken from a side track of a steam railroad, and drawn for about one-half mile by an electric locomotive through the streets of a city, where a steam locomotive would not be tolerated. This provides a quiet, clean and convenient means of transportation, making it unnecessary to unload these and other goods at the side track on to wagons, according to old-fashioned methods, and unloading them again at the point of delivery. This makes a saving of expense for carting that is not included in the above statement of percentage saved.

* * *

Oil fuel is used at the central power station of the New Orleans drainage works, which supplies current to a number of electric pumping plants. Sudden heavy rains made it necessary to start up rapidly and oil has proved better than coal.

AN EMERGENCY TRACK BRAKE.*

BY F. F. BODLER,
Master Mechanic United Railroads of San Francisco.

The emergency track brake, hereafter to be described, is used on practically all the cars in San Francisco. While San Francisco is an ideal city for operating street railways in many respects, especially as regards the absence of snow, ice and sleet, yet it has its drawbacks, namely, an enormous number of steep grades. In order to operate safely over these in wet weather and on slippery rails it was necessary to provide another means of braking a car than the wheel brakes. This is successfully accomplished by means of the track brake.

The first experiment with track brakes was made in 1883 or thereabouts, when the Market Street Railway Company built a cable line on Market street. The brake was similar in principle to the present brake. It was placed on the rear truck and operated by a hand lever placed alongside of the grip lever.

In 1893 the Market Street Railway Company consolidated with several other lines and in 1894 commenced to change the motive power of some of its lines from horse and cable to electric. The first cars were of the single truck type, and were equipped with wheel brakes only. It was immediately discovered that an emergency brake was needed, as the cars could not be controlled on the grades, although the tracks were well sanded, and the wheel brakes were powerful enough to lock the wheels. This condition had not been met with on cable cars, as the cars could not go faster than the cable.

In 1895 G. W. Douglas, then master mechanic of the Market Street Railway Company, started to experiment with a track brake on electric cars. Twelve single truck cars were equipped with track brake and operated successfully until 1899. In that year Mr. Douglas reconstructed his brake, and made it applicable to double as well as to single trucks. This is the brake which is now so successfully used in San Francisco.

Primarily the brake (see Fig. 1) consists of a hand lever connected by a brake rod to an arm keyed on a rocker shaft extending clear across the truck. This shaft is connected on each end by means of a short lever, keyed to the shaft, to a connecting link and to a toggle lever. The connecting lever is connected to a lever keyed to a short shaft and to a toggle lever. The shell for holding the shoe is connected to the toggles by means of the heels.

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*Paper read at the annual convention of the American Railway and Mechanical Association, held at Philadelphia, Pa., September 25-26, 1905.

By pulling back on lever the shaft turns from left over to right, tending to make the short lever assume a vertical position This motion is transmitted to the long lever by means of a connecting lever. The simultaneous parallel movement of the levers causes the toggle levers to assume a vertical position and to force the shoes to the rail. The heels, one on each side of a channel iron across the truck, act as a guide and allow the shoe to travel only in a vertical direction.

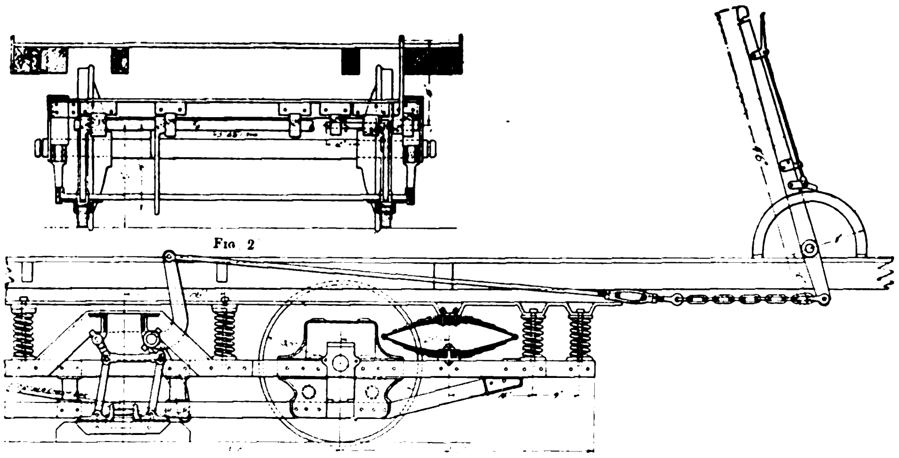

Fig. 1.—Track Brake Applied to Peckham Truck.
Fig. 2.—Sectional View of Same.

A lever with a counterweight attached to it, keyed to the shaft at any convenient position or bolted to the arm, acts as a release.

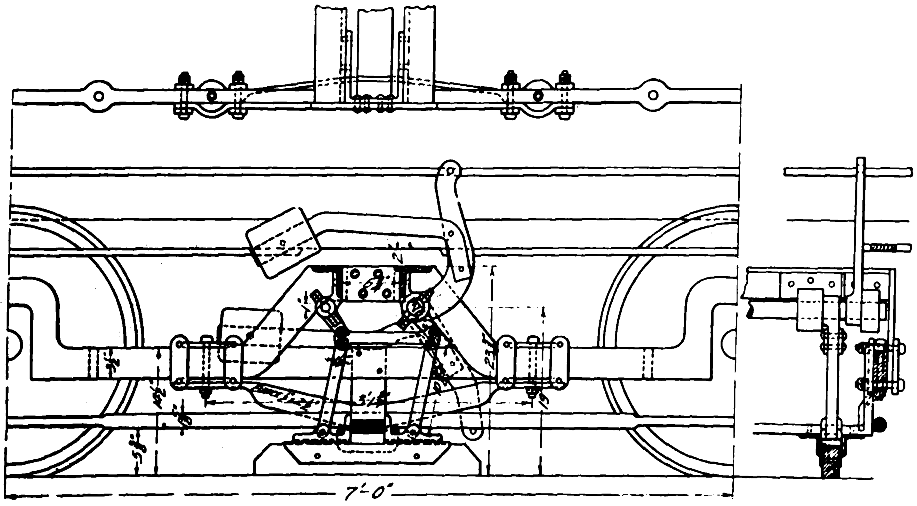

Fig. 3.—Track Brake Applied to Brill Single Truck.

In order to adapt this brake to a Peckham or Brill single truck it is necessary to fasten a flat iron, bent as shown, to the side frames, using the holes on each side of one of the spiral body springs. Two angle irons are placed transversely across the truck and fastened to the bent flat iron. To these angle irons the brass boxes for holding the shafts are bolted. The large shaft is held in position by three boxes, one on each end and one near the arm. The short shaft is held by two boxes, one on each side of the lever.

To operate the track brake from the opposite end of the car an arm is keyed to the shaft, the brake rod being placed under and on one side of the motor, as shown in Fig. 2.

Considerable ingenuity had to be exercised in order to place these brakes on all cars. The arm, for instance, in many cases had to be placed under the seat, the floor having been cut out. With a single truck car the relative position of the arm on the shaft does not make any difference. Fig. 3 shows the brake applied to a Brill single truck.

This brake is placed on double trucks, in practically the same manner as on a single truck, except that each truck has an independent brake, operated from the end nearest the truck. On double trucks the rocker shaft boxes are fastened directly to the tramsom angle irons. The arm has to be placed in the middle of the shaft on account of the swing of the truck.

Fig. 4 shows a Brill 27-G truck, and Fig. 5 a Peckham 13-B-3-S truck with this brake.

Fig 6 shows a standard track brake shoe. This shoe is made of Oregon pine, costs about $.0275 and lasts about one week. The material to be used for shoes was the subject of many experiments. All kinds of wood, all kinds of metal, combinations of wood and metal, and metal with all kinds of inserts were experimented with. For cheapness, general utility and the highest braking efficiency the Oregon pine shoe was found to be the best. The shell for holding the shoe is made in two parts of pressed steel. Two bolts pass through the holes shown in the shell and through the recesses shown in the shoe, not only clamping the shoe by means of the shell, but also preventing the shoe from slipping backward or forward. In order to facilitate the removal of worn out shoes, sections of rail slightly longer than the shoe are sawed off and hinged on the car house tracks. The cars are placed with the shoes over these hinged rail sections, the hinged rail is swung out, and by loosening the two bolts the shoes drop out.

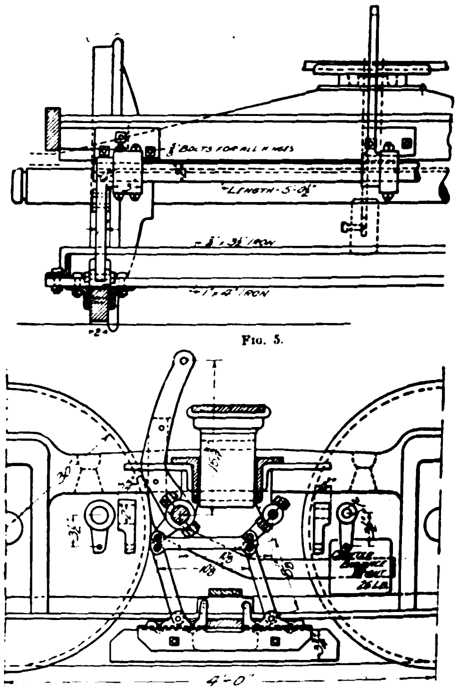

Fig. 4.—Track Brake Applied to Brill G-27 Double Truck.
Fig. 5.—Sectional View of Same.

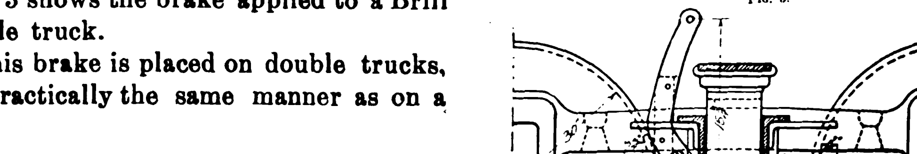

Fig. 6.—Standard Track Brake Shoe.

The time required for replacing four shoes on a double truck car is about two minutes. The shoes can be adjusted when partly worn by inserting wooden shims between the top of shoe and shell.

As seen by various sketches this brake

can only be applied on trucks having outside hung wheel brakes. On double trucks it can only be used when the bolster spring is half elliptic and hung under the side frames. It cannot be used on M. C. B. bolsters on account of lack of room. In fact it requires close figuring to adapt it to the above mentioned trucks, in order to prevent the bolster from coming down on the connecting lever, F.

It has been proved that the brake is most effective when brake levers, as shown in the sketches, are used. The efficiency of the brake is proportionate to the rapidity and force with which the shoe is brought down on the rail. An ordinary ratchet handle with the ordinary spindle is of little use. With a cam on the spindle it is decidedly more efficient.

The strong points in this brake are:

1. Its extreme simplicity.
2. Its high efficiency.
3. Its low cost of maintenance.
4. Its independence of all other brakes.
5. Its being purely a mechanical contrivance.

This brake can readily be operated by compressed air by the addition of a brake cylinder. To the writer's knowledge it has not been operated by that means, however.

Whether it would be as successful in cities where there is much snow, ice and sleet, as it is in San Francisco, the writer would not care to say, yet there does not seem to be any reason why it should not.

It may appear to some that on account of taking considerable weight off the wheels there would be danger of skidding the wheels, yet the number of flat wheels has steadily decreased since these brakes were put on. The reason for this is probably that there is no need of "cinching" the wheel brakes up so tight as there was formerly.

Cars are operated over one 17.5 per cent. grade, four 14.5 per cent. grades, and any number over 10 to 12 per cent. grades.

A single truck car, weighing 10 tons, can be stopped on the steepest grade over which electric cars are operated in the city, in a reasonable distance, by first applying the wheel brakes and then the track brake.

The original intention was to use this brake only as an emergency brake; it has been found so serviceable, however, that it is used almost as much as the wheel brake is. It ought not to be used on curves, switches or crossings, but should it be used, about the only damage resulting would be a split shoe.

CENTRAL STATION DESIGN—AN EXACT SCIENCE.*

An American writer has counseled the youth of his own and succeeding generations as follows: "Aim high; you may not hit what you aim at, but you will shoot the higher for the aiming." It is the privilege of youth to bestow a certain amount of time and energy on the attempt to realize the ideal, and truly the world would be a less interesting place in which to live if this were not the case. When, however, this attitude of mind is exhibited by older men, and in the sphere of business, it lays itself open to adverse criticism, as having strayed out of its legitimate field of poetry or philosophy. Occasionally, even in the prosaic routine of central station work one comes across what would appear to be manifestations of such a tendency, and in this case the results are likely to conduce to unproductive extravagance.

It is still, apparently, an unsettled problem in many minds whether a public generating station shall be regarded strictly on business lines as a revenue-producing concern, or whether it shall be a sort of exhibition, attempting, and often with too great success, to cover the utilitarian with a cloak of æstheticism. Perhaps it is not altogether an advantage that the electrical industry should lend itself so aptly to æsthetic treatment, insidiously flattering the *amour propre* of the members of our local authorities and stimulating them to financial recklessness. There is beauty, no doubt, in a wonderfully swept and garnished engine room, but one would also point out the attractiveness of a favorable balance-sheet.

It is only to be expected that a commercial undertaking of such mushroom growth as is that of the generation and distribution of electrical energy, should provide instances of very varied arrangements resulting from the existence of widely different conceptions as to the object, and the means of attaining that object, of the industry.

Where progress has been so rapid, the interval between ancient and modern must inevitably be of short duration, and the reign of one type of apparatus must be superseded almost immediately, owing to the evolution of newer ideas. So much has this been the case that engineers have rushed from one extreme to another, forgetting in many cases the claims of the older type in the attractions of the new. As a natural result many of our modern power stations (if a station may be regarded as modern after having been in existence ten years) present a most extraordinary conglomeration of plant, mechanical and electrical, of all sizes and shapes.

It is, however, a task of no great difficulty to be wise after the event, to indicate early mistakes in the light of present wider knowledge, and the points proposed for consideration here consist not so much in the choice and arrangement of a type of plant as in a glance at the general aim and the clearness of vision with which efforts have been directed towards it. Neglecting the æsthetic point of view previously referred to, and omitting from our inquiry such stations as exemplify it, we may presume that, in the generality of cases, the main objects sought are efficiency and economy. Let us see how these laudable aims are in course of achievement. We need not go to older stations for examples—our present-day works, now in course of erection, will yield sufficient matter for a short inquiry.

It has been said, and perhaps with some degree of truth, that "consistency is the bugbear of small minds," and one is inspired to hope that herein lies the explanation, difficult to find otherwise, of the very large number of inconsistencies exhibited in the average specification for plant. Who has not seen specifications calling for a definite steam consumption to the second place of decimals, while the methods sometimes selected for ascertaining whether the guarantees have been attained may themselves be questioned as to accuracy within 5 per cent.? Of what conceivable service can be the guarantee of combined efficiency of a generating set, when the only method of checking it involves the use of the indicator, itself subject to a possible error of quite this amount?

Whether or not the engineers responsible for these and other similar anomalies can take shelter under the quotation mentioned, it may be argued that the question at issue is not so much one of consistency as of another commodity of a much more ordinary kind, viz., common sense.

In a recent specification which came under the writer's notice several switchboard instruments of various types were called for. The ammeters reading from zero to 2,000 amperes were required to have an 8-inch scale, and to be accurate within .5 per cent. throughout the range of the instrument. It is a simple calculation to see that the pointer must be true to its position within an amount not exceeding $\frac{1}{25}$ of an inch at all readings, while the needle itself would, in an instrument of this size, be probably nearly $\frac{1}{16}$ inch broad at the point. The voltmeters, and also the wattmeters, were required to come up to an equally unattainable standard, and it would appear that the engineer was not satisfied that his conditions were even then sufficiently stringent. To give still further evidence of misdirected zeal it was specially required that the errors must be inclusive of any temperature effect; and finally the ammeters were carefully placed within 6 inches of large bus-bars, on which the current would vary in intensity from almost nothing up to 4,000 or 5,000 amperes.

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* Communicated to the "Electrical Review," London.

The precise object of all this is not quite clear, and one cannot help wondering whether some latent vein of humor has not been rather expensively indulged to the discomfiture alike of the instrument maker and also of the station engineer. It is far from our present intention to decry or discredit exactness and accuracy; let us be exact by all means, but it is preferable to exhibit the quality in a rather more sane and less pretentious manner.

If such accuracy could be insisted upon and carried through all departments of central station plant, the works would, at any rate, be efficient, if perhaps somewhat difficult of operation. Unfortunately, however, it is usual to find that such labored exactness in detail has had the effect of allowing very serious objections to occur in the general design of the plant.

The use of the microscope is said to deteriorate the power of the eye for ordinary vision, and it is to be feared that in close attention to the small and comparatively insignificant trifles in the arrangement, the broad lines of design are frequently neglected. It would appear that the sense of proportion becomes obscured, and the close scrutiny which should be given to the *tout ensemble* is bestowed only on some of the component parts.

The question of steam consumption of generating sets was referred to previously in the present article, and may well form the subject of a somewhat fuller consideration, as it is apparently a point far too much labored. Of what advantage is it to the station engineer to possess combined sets where everything is cut abnormally fine to save a quarter of a pound of steam per kw.-hour on test, when his steam range condensation, steam-driven auxiliaries and leakage from joints are accountable for probably far more steam than is consumed by the actual generating plant itself?

It is to be presumed that most stations can generate from their machines at the cost of something like 25 pounds of steam delivered at the engine per unit. On examining the records of these stations, we find that the average amount of steam required per unit throughout the year is in the neighborhood of 50 to 60 pounds, and in some cases considerably higher. To obtain the low steam consumption guarantee, engine clearances must be reduced to the finest possible limit, greatly increasing the liability to serious accident, and also, of course, the first cost, while, as is shown in the foregoing figures, the net gain, if any, to the station is practically negligible.

In the steam turbine particularly, a prime mover for which there is undoubtedly a very wide field in the future, the clearance between rotor and case is made so slight with a view to the exaction of the last fraction in steam consumption, that one constantly hears of blades stripped through too rapid starting. It is difficult to see the use in a power station of a machine which may be very economical when running but which requires half an hour to one hour's warming up before it can be set to work, and in which a comparatively trivial amount of wear in a main bearing is likely to produce disastrous results. One is aware that this is rank heresy to most consulting engineers, but one still holds to the opinion that truer economy would be achieved by sacrificing the steam consumption guarantee, in increasing the clearances somewhat, and being able to take the 5:30 train home and cultivate a peaceful habit of mind.

It should be remembered that the first essential condition in our industry is absolute reliability of supply, and, secondly, economy of production, although we are far from admitting that such a slight sacrifice of efficiency as that contemplated would materially, if at all, affect the latter consideration.

There is another phase of the question which a station engineer rather shrinks from advancing, viz., the wear and tear of the engineer himself. The knowledge that his work is dependent on the maintenance of a 2 mm. clearance is not stimulating to reposefulness. It may be, if the present craze for the highest test-plate efficiency is maintained, that our municipal Cæsars will be exclaiming:—

> Let me have men about me that are fat,
> Sleek-headed men, and such as sleep o' nights;
> Yond' —— hath a lean and hungry look,
> He thinks too much.

Another phase of the subject of anomalies in central station design is introduced in the installation of labor-saving machinery under conditions which cannot possibly result in economy. Such examples as fuel-conveying and elevating gear and mechanical stoking appliances serve to illustrate this. Such apparatus would undoubtedly form a part, and a very valuable part, of the plant of a station operating under ideal conditions, but coming to the actual and dealing with load factors which are very far from ideal, they can in very few cases justify their selection on the score of economy alone. It is difficult to understand the attitude of mind of the councillor who votes for such embellishments, and at the same time provides unremunerative labor for the unemployed section of his constituents.

Instances might be multiplied *ad infinitum* to advocate the cause of simplicity in station design, but enough has, perhaps, been said to indicate a train of thought worthy of more mature consideration.

WRINKLES.*

EDITED BY H. C. ABELL.

A Handy Light for Night Testing.

A handy arrangement for reading instruments at night, when testing transformers and locating trouble, was made by taking an incandescent lamp out of a Christmas-tree set and fastening it to a swinging bracket mounted on a lap board large enough to hold the instruments and record book. The current was supplied by 12 dry cells connected in series and mounted in a box carried in the bed of the wagon and connected to the lamp by lamp cord. This set has been in use for several months, and the batteries do not run out like those of the hand flashlight sets. J. F. DOSTAL, Denver, Col.

Interconnection of Feeder Systems.

In remedying the chaotic condition of affairs in Schenectady by placing the feeders in the business portion underground, we have been compelled to so connect our various feeders that one feeder may furnish current for the one adjoining it in our system of distribution. This was made necessary by the fact that the system of feeding from our old station was overhead, while the system at our new station was underground. It became necessary to start our new station before our underground system was completed, and we were therefore compelled to place current on our primary underground feeders in order to supply our overhead system from the pole taps carried in the cable boxes at various locations.

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*Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

After we had completed the connections between our primary, three-phase underground and overhead feeders, and had placed them in operation, we began to interconnect our overhead system by carrying the three phases of the overhead system from some point near the cable box to some point accessible to the three-phase overhead system of an adjacent feeder in our system of distribution. These interconnecting leads were in some instances a part of one of the two feeder systems to be connected, and in most cases it was only necessary to run a third wire and extend our single-phase lighting primary in order to give us this three-phase accommodation.

Where the two feeder systems were brought together we used an expulsion type of fuse box, testing out the leads to be placed in the fuse boxes with a potential transformer in order to bring the proper phases of the two feeders into the same fuse box. As the drop of our feeder system during the day is very slight, we cut out our feeder regulators, the voltage on all feeders being practically the same. By this arrangement you will notice it was possible for us to feed our overhead system of distribution from an adjacent feeder during the time of light day load by plugging in the fuses mentioned and pulling off the underground feeder from any given section from which we desired to work. This has made it possible for us to make our proper primary underground taps and connections, and develop our underground system and still continue feeding from our new station.

In the business sections of the city we continued to supply current from our overhead secondary, which in turn was supplied with current from our overhead primary, which received its current in turn from the underground primary system. Each day we fed this overhead system from an adjacent feeder and cleared the underground primary feeder in the business sections, thus being able to continue work regularly on an underground system of primary and secondary feeders.

As all of our feeder systems are fed from one common 2,300-volt, three-phase 'bus, it made it possible for us to place these feeders in multiple by testing out the phase with a potential transformer of about 50 watts capacity, using a lamp on the secondary of the same. We find this a much better and safer method of phasing our lines than the old method of using a long piece of fuse and a stick.

L. O. RIPLEY,
Mgr. Schenectady Illuminating Co.

United States Telephone Independents Effect Permanent Organization.

A dispatch from Rochester, N. Y., says that announcement was made on Saturday that the United States Independent Telephone Company had that day completed its permanent organization at a meeting held in Rochester.

Thomas W. Finucane, the new president of the company, says that the company authorized its collateral trust mortgage of $25,000,000, and the underlying securities will comprise control of the Stromberg-Carlson Telephone Manufacturing Company, which manufactures a thousand telephones a day, and the New York Independent Company, which latter owns franchise rights claimed to be similar in character and scope to those of the Bell Company.

It is proposed to install a plant with an initial capacity of 225,000 telephones and an ultimate capacity of 750,000 telephones for New York City and the tributary districts which environ it.

The directors include Adolphus Busch, August Gehner and Breckinridge Jones, of St. Louis; George Eastman and Eugene Satterlee, of Rochester; Robert C. Hall, of Pittsburg; Joseph J. Heim and O. C. Snider, of Kansas City, and Hendrick S. Holden, of Syracuse.

Big Traction Deal.

A syndicate composed of Thomas Dolan, Randall Morgan and other men identified with the United Gas Improvement Company of Philadelphia, have bought of Tucker, Anthony & Co., of Boston, control of their extensive traction interests in Indiana and the Ohio Valley. The deal involves the payment of between $6,000,000 and $7,000,000 in cash, and carries control of the Indianapolis & Western and Indianapolis & Northwestern Traction Companies and a number of other important traction and electric lighting properties.

Lectures on Electricity.

The Board of Education of New York has provided for an interesting course of public lectures to be given by W. Wallace Ker on Tuesdays during the months of October, November and December, at the central branch of the Young Men's Christian Association, Fulton and Bond streets, Brooklyn. The course commenced on Tuesday evening and consists of ten lectures.

G. A. Rodenback, a graduate of the University of Wisconsin, has been appointed assistant in the department of electrical engineering at the Massachusetts Institute of Technology, Boston.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED OCT. 3, 1905.

Electric Railways and Appliances.

800,762. Trolley-Pole. Andrew L. Prentiss, Buffalo, N. Y. Filed Oct. 18, 1904.

800,816. Motor-Controller. Samuel S. Neu, New York City. Filed Oct. 10, 1904.

801,049. Railway Signaling System. Karl Scholz, Liebauthal, Austria-Hungary. Filed April 27, 1905.

801,165. Railway Signaling System. Herbert B. Taylor, East Orange, N. J., asssignor to the Advance Signal Company, Newark, N. J. Filed May 15. 1905.

Electric Lights and Appliances.

800,899. Incandescent Lamp. Frank M. Brooks, New York City. Filed Sept. 17, 1904.

800,993. Turn-down Incandescent Lamp. Samuel E. Doane, Cleveland, O., assignor to the National Electric Lamp Company, same place. Filed Nov. 16. 1904.

Electrical Machinery and Apparatus

800,823. Electrical Protective Apparatus. Charles A. Rolfe, Adrian, Mich., assignor, by mesne assignments, to the Rolfe Electric Company, Rochester, N. Y. Filed Feb. 13, 1903.

800,909. Controller-Regulator. Cyrus P. Ebersole. Keokuk, Ia., assignor to the Electrical Devices Company, same place. Filed July 23, 1902, Renewed May 5, 1904.

Telephones and Telephone Apparatus

800,675. Telephone-Receiver. Hermann G. Pape, New York City. Filed June 16, 1904.

800,747. Key for Telephone switchboards. Frederick H. Loveridge, Chicago, Ill., assignor to the Western Electric Company. Filed Dec. 13, 1902.

800,767. Telephone-Transmitter. Philip J. Spies and Rudoph C. Deuben, Chicago, Ill., assignor to said Spies and John M. Klein, a copartnership, same place. Filed Nov. 1, 1902.

800,855. Telephony. Isidor Kitsee, Philadelphia, Pa. Filed June 30, 1904.

800,907. Antiseptic Telephone-Mouthpiece. William B. Curtis, San Francisco, Cal. Filed April 18, 1905.

800,940. Telephone-Transmitter. Jerome Prince, Milford, Mass., assignor, by direct and mesne assignments, to the Prince Telephone Company. Filed Aug. 18, 1902.

801,034. Telephone-Receiver. William J. Murdock, Boston, Mass. Filed Jan. 5, 1905.

Miscellaneous.

800,619, Reversible Galvanic Battery. Charles B. Askew, Chicago, Ill. Filed Aug. 24, 1903.

800,638. Storage Battery. William Gardiner, Chicago, Ill., assignor, by mesne assignments, of one-hundred and fifty-one two-hundredths to the Universal Electric Storage Battery Company, same place. Filed June 11, 1904,

800,756. Protective Apparatus for Electrical Instruments. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company. Filed Dec. 7, 1904.

800,834. Weather-Trap for Electric Wires. William H. Roney, Chicago, Ill. Filed Nov. 3, 1904.

800,854. Wireless Telegraphy. Isidor Kitee, Philadelphia, Pa. Filed Feb. 8, 1902.

800,873. Electrical Measuring Instrument. Edwin F. Northrup, Philadelphia, Pa., assignor to the Leeds & Northrup Company, same place. Filed Nov. 19, 1904.

800,885. Electric Cooking Apparatus. Gustav Teuber, Laasphe, Germany. Filed April 27, 1905.

800,902. System of Electrical Distribution. Rufus N. Chamberlain, Depew, N. Y., assignor to the Gould Storage Battery Company. Filed Jan. 12, 1904.

800,935. Electric-Wire Tower. La Verne W. Noyes, Chicago, Ill. Filed Feb. 11, 1904.

800,946. Polarized Electric Bell. Samuel C. Shaffner, Mobile, Ala. Filed July 15, 1903.

801,035, Electric Bell. William J. Murdock, Boston, Mass. Filed July 21, 1904.

801,132. Electrical Means for Detecting Contact Between Two Connecting Bodies. Mark Barr, Kensington, England, assignor to the Linotope Company, Limited, London, England. Filed May 31, 1901.

801,190. Electric Semaphore. Clayton E. Frederickson, Denver, Col., assignor of one-half to Jean F. Webb, same place. Filed Jan. 23, 1905.

THE TELEPHONE WORLD.

Takes Initial Step for New Telephone System.

Mr. J. J. Heim, on his return to Kansas City, Mo., from New York, where he paid a $100,000 filing bill on a $50,000,000 charter for the United States Telephone Company, gave out this statement: "This company is to be to the Independents what the American Telephone & Telegraph Company is to the Bell Companies. We have bought the Stromberg-Carlson Electric Company, which is to be to us what the Western Electric Company is to the Bell. We have bought the Independent companies in Rochester, Utica, Syracuse, and other important New York up-State points, and have secured a charter to allow us to invade the City of New York. There is only one company there now. We are going into that field to see what we can do with it as a competitor."

New Rules for Keystone Company.

By recent action of the Keystone Telephone Company's stockholders, the directors are deprived of the power to sell any of the corporation's real or personal property until a vote has been taken by the stockholders.

The meeting a special one, was held in Camden, N. J.

When Fiske & Robinson, of New York, recently obtained an important financial interest in the Keystone Company, and also got representation in the management, it was noticed that the New Jersey company owned most of the stock of the Philadelphia company and that under the present by-laws the board of directors could sell the property of the company without consulting the stockholders. It is believed that the action taken will put an end to the rumors that frequently occur that the conduits of the Keystone Company are to pass into the control of other concerns.

At the coming session of the South Carolina Legislature a bill will be introduced to require the Southern Bell Telephone Company to connect with all the small Independent lines in the State. The railroad commission is now investigating the telephone situation to find the cost of connecting lines, and the rates that would be equitable for long-distance connections.

Advices from Rochester, N. Y., state that the United States Independent Telephone Company will have control of a majority of the stock of the Rochester Telephone Company at 200 before the end of the year.

H. N. Mayberry, acting supposedly in the interests of the Home Telephone Company of Berkeley, Cal., has applied for a franchise there The trustees referred the petition to the street committee.

Articles of incorporation have been filed by the St. James Telephone Company of St. ames, Minn. Its capital stock is $25,000.

The Fowler Independent Telephone Company of Fowler, Cal., has been incorporated with a capital stock of $7,500.

A. B. Hunt, T. E. Parmalee and T. H. Polloch are after an Independent franchise in Omaha.

Independent and Bell Companies Chasing Prospective Subscribers.

Advices from Winona, Minn., say that the telephone war between the Winona (Independent), and Northwestern (Bell) Telephone Companies is on in full force. As a result of the recent annoucement of the Northwestern Company that it would raise rates to a level with those of the home company, the Winona Company has begun a vigorous canvass among the subscribers of the Northwestern Company. It is said that all the doctors of Winona except two have signed an agreement to cut out the Northwestern 'phone.

The Northwestern Company has placed a large force of solicitors in the field to hold its present subscribers and get additional ones. Both companies are using printers' ink liberally. The Northwestern Company has the largest list of city subscribers, but the home company has a complete county service among the farmers of the county and exclusive service in all city offices and schools and most of the county offices

Texas Clearing House for Independents.

The Texas Independent Telephone Clearing House Association has been organized at Dallas and application made to the Secretary of State for a charter.

The purpose of the organization is to facilitate the concentration of Independent telephone business in Texas. This will be a mutual benefit to several scores of telephone companies operating over the State.

The Fort Worth Telephone Company reports that its line into Dallas will be completed and ready for business on or about the first day of November.

Long distance connections have been recently completed from Fort Worth to Waxahachie, Waco, Houston, San Antonio and intervening points by this company.

At the annual meeting of the stockholders of the Frontier Telephone Company held in Buffalo, N. Y., the following directors were elected to serve for the ensuing year: William H. Andrews, Charles E. Austin, Martin Carey, Robert W. Chapin, William A. Douglas, Charles W. Goodyear, R. R. Hefford, Bert G. Hubbell,' Clark L. Iugham, Andrew Langdon, F. C. M. Lautz, H. H. Littell, E. C. Lufkin, H. H. Persons and George A. Plimpton.

It is stated that the party of Toledo, O., capitalists who some months ago promoted the Cuyahoga telephone deal, are negotiating for the control of the Independent Co-operative Telephone Company of Detroit, and that the property will likely pass into their hands.

The Bell Telephone Company is installing a conduit from Wilmington, Del., to Philadelphia, Pa., in which to place its trunk wires.

W. A. Wynne, of Raleigh, N. C., has secured a franchise to install and operate an Independent underground telephone system.

J. B. Pierce will act as general manager of the Independent Telephone Company of Syracuse, N. Y.

Bell Company Appointments.

The following appointments have been announced by the American Telephone & Telegraph Company:

H. S. Brooks, formerly district superintendent first district, to assist general superintendent, with headquarters in New York City.

Charles H. Fuller, formerly manager, Boston, Mass., district superintendent first district, vice Brooks; headquarters in New York City.

Henry McDonald, manager, Boston, Mass., vice Fuller.

J. L. Van Meter, superintendent of traffic at the head of the bureau of traffic; headquarters in New York City.

The Quincy Telephone Company of Quincy, Ill., which procured its franchise about a year ago, has sold its $500,000 issue of bonds to a St. Louis syndicate, which includes J. H. Murphy, a broker, and Charles Sutter, who recently assisted in consolidating the car concerns, representing a value of $50,000,000. The firm of Herman & Schatzman, brokers of Quincy, is understood to be financially engineering the project. The work of construction will begin immediately, and is expected to be completed by next April. Long distance connection will be made with St. Louis and Chicago, and about 5,000 telephones will be installed.

At the annual meeting of the Interstate Telephone & Telegraph Company of Aurora, Ill., the 17th regular quarterly dividend of 1 per cent. was declared on the entire capital stock of the Interstate Company. The report for the fiscal year ending June 30 also showed an increase of nearly $20,000 in the surplus over and above fixed charges, including interest and dividends, which was considered by the full board to be very satisfactory.

John L. Dunlop and J. M. Fetter, of Louisville, Ky., have been selected to do the underwriting in Kentucky for the United States Independent Telephone Company. The United States Company is a merger of a number of large telephone companies. It is capitalized at $50,000,000. The apportioning of the underwriting is in the hands of Breckenridge Jones, of the Mississippi Valley Trust Company of St. Louis.

Telephone Incorporations.

The Cream City Telephone & Telegraph Company, Jersey City, N. J.—to do a general telephone and telegraph business. Capital stock, $125,000. Incorporators: E. W. Dennison, Orange, N. J.; Norman Malcolm, Chicago, Ill., and William Lohman, New York.

The West Valley Telephone Company, West Valley, N. Y. Capital stock, $3,000. Incorporators: Christian Ehman, William H. Proctor, Fred E. Link and others, all of West Valley.

The Bath & Mitchellville Telephone Company, Bath, N. Y. Capital stock, $1,000. Incorporators: Clarence Myrtle, Thomas W. Robinson, Martin Armstrong, Leroy Keeler and Clarence G. Carey, all of Bath; Frank O. Rice, Wheeler, and Henry Faulkner, Urbana

GENERAL ELECTRICAL NEWS.

LIGHTING.

Athens, Ill.—The electric light plant in this city has been sold by Burnett & McMasters to Charles Carr, of Virden.

Burlington, Wis.—Taxpayers are making a determined fight against the establishment of a municipal electric lighting plant here and the issuance and sale of $12,000 bonds to pay for the same. Leonard J. Smith secured an injunction against the city, Mayor Mutter and City Clerk John T. Prasch, restraining them from proceeding in the matter. It is alleged that the recent vote was not legal because a two-thirds vote of the city did not ratify the plant.

Chatham, N. B.—This town has voted to apply to the Legislature for power to issue bonds for $35,000 for the purpose of erecting a new electric lighting plant.

Chicago, Ill.—John H. Radford is preparing plans for an addition to an electric light plant at 58th and Cottage Grove avenue to cost $200,000.—The Federal Electric Light Company's plant was lately destroyed by fire. The loss is $2,500.

Cicero, Ind.—The work of setting poles and stringing wires for an electric light plant is now in progress.

Depue, Ill.—This village is to have an electric lighting plant. A franchise for this purpose was granted at a recent meeting of the town board.

Ellwood City, Pa.—The Ellwood Electric Light Company has completed arrangements by which it will conduct electricity to Zelienople for lighting and power purposes.

Hastings, Neb.—The municipal electric light and power plant will have greatly enlarged capacity in the addition of a 400 hp. engine with generators, etc., costing between $15,000 and $20,000.

Holdenville, I. T.—The Charles De Watteville electric light and ice plant was lately destroyed by fire. The loss is estimated at $25,000.

Key West, Fla.—Ladd, Larkias & Jerguson have applied for a franchise to operate an electric light plant.

Kutztown, Pa.—This borough will soon have one of the finest electric light plants in the State. It will cost $15,000. Crude oil is to be used for fuel.

Lawrenceburg, Tenn.—This town will vote October 23 on the issuance of $25,000 of bonds for the installation of waterworks and an electric light plant. Address town clerk.

Milwaukee, Wis.—The resolution providing $60,000 for the purchase of a site for a municipal lighting plant has been signed by Mayor Rose.

Petoskey, Mich.—Petoskey proposes to obtain power for its electric light plant from the Boyne Falls Power Company, located at the falls of the River Boyne, 16 miles south of here.

Port Washington, Wis.—A municipal lighting plant and waterworks will be erected here.

Richmond, Va.—The joint sub-committee from the committees on finance, electricity and water, met lately and after carefully considering the report of Consulting Engineer E. W. Trafford on the proposed municipal light and power plant, adopted a resolution requesting the city attorney to prepare an ordinance for the issuance of $500,000 of 4 per cent. electric light plant bonds, and to draw all other ordinances necessary to put the scheme into operation and report back to the committee. The plant is to have a capacity of 2,000 hp., capable of being increased to 4,000. It is estimated, if none of the products of the plant are sold, it would save the city $37,000 annually in the cost of power and lights alone.

Tallapoosa, Ga.—This city will vote October 16 on the issuance of $10,000 of bonds for the construction of an electric light plant. George W. Sheppard, mayor.

Vinita, I. T.—The Vinita Electric Light, Ice & Power Company's plant was destroyed by fire, entailing a loss of $5,000.

Wisner, Neb.—The town authorities of this city have awarded the contract for an electric light plant to cost $5,000.

Woodward, Okla.—The Woodward Cotton Company has been granted a franchise by the council to furnish this city with electric lights and power for 20 years.

Wynnewood, I. T.—The city council has decided to call an election to vote on issuing bonds in the sum of $40,000 to build a system of waterworks and electric lights.

STREET RAILWAYS.

Brazil, Ind.—The surveyors for the Indianapolis & Ohio Valley Traction Company have begun the work of surveying through the city.

Champaign, Ill.—The Illinois Traction Company of this city has increased its capital stock from $5,500,000 to $7,500,000.

Connersville, Ind.—Work will begin on the traction line in this city at an early date.

Enid, Okla.—The city council has granted a street railway franchise to Daniel S. Roberts, of Baltimore. The system will cost at least a quarter of a million dollars.

Hamilton, Ill.—Survey work on the proposed trolley line between this city and Carthage was lately begun, and work on the line will commence at an early date.

Indianapolis, Ind.—The Louisville & Indianapolis Traction Company, the object of which is to construct and operate an electric line between Columbus and Jeffersonville, was recently incorporated with a capital of $10,000, by John R. Schindel and Samuel Adams.

Kalamazoo, Mich.—The electric line between this city and Grand Rapids seems to be an assured fact, work having already commenced on the road bed.

Lancaster, O.—There will be a new third rail line to Buckeye Lake next year. The Scioto Valley Company has surveyed and staked out the route with a branch line from Carroll to Millersport.

Madisonville, Ky.—Work will soon begin on the Madisonville traction line, which is to be built from this city to Nortonville, a distance of about 11 miles, making connection with the Illinois Central at that point. Mr. W. C. Morton says that deeds to all the right-of way have been secured, and just as soon as arrangements can be made for franchises through the streets of the small towns along the route work will be commenced.

McKeesport, Pa.—Work has been started by the West Penn Construction Company on the laying of tracks for the new trolley line from this city to Irwin.

Pittsburg, Pa.—A trolley line is to be built between Wilmerding and Wall in the near future. Subscriptions for stock in the company to the amount of $15,000 have already been received from Wilmerding people, and as only $25,000 is needed the road will soon be started.

Vincennes, Ind.—The officials of the Vincennes, West Baden & Louisville Traction Company have awarded the contract for the construction of the road and the erection of a power house to Louis Metesser, of New Orleans. The road will cost $3,000,000.

Willimantic, Conn.—The Willimantic Traction Company, which two years ago built a line 10 miles in length from this city to Baltic, has transferred the property to the Consolidated Railway Company, the holding company of the New York, New Haven & Hartford Railroad Company's trolley lines in Connecticut.

POWER PLANTS.

Bowling Green, O.—The county commissioners are about to give to the contractors the plans for a new power plant.

Colorado Springs, Col.—The Animas Power & Water Company of this city has been incorporated with a capital stock of $3,000,000 by L. E. Curtis, Henry Hime and O. B. Wilcox.

Duluth, Minn.—Contractors are now preparing proposals for the construction of the power distributing station for the Great Northern Power Company to be erected at Superior street and Fifteenth avenue.

Muskogee, I. T.—The Muskogee Commercial Club has received a proposition from G. W. Sargent, of Joplin, to build the Grand River power plant.

Whitney, N. C.—The Whitney Company, of which George L. Whitney, of Pittsburg, is president, has planned to erect an immense power plant here. The T. A. Gillespie Company of Pittsburg has the contract for the dam, canal and power house at about $2,000,000.

BIDS WANTED.

Fort Leavenworth, Kan.—Sealed proposals will be received until October 27 for the construction of five double sets of lieutenants' quarters, including plumbing, heating and electric wiring, at Fort Leavenworth. Envelopes to be indorsed "Proposals for Public Buildings," and addressed to Captain J. W. Normoyle, quartermaster.

Washington, D. C.—The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until October 17 for furnishing Eastern Navy Yards with the following supplies: Schedule 153, arc and desk lamps. outlet boxes, wire, wireless clusters, cabinet and distributing boards and miscellaneous electrical supplies; schedule 154, double conductor; schedule 155, incandescent lamps, carbons; schedule 157, electric deck hoists; schedule 158, copper wire, steel conduit and fittings, electrical supplies. Specifications and blank proposals can be obtained at the Navy Pay Office in New York, or upon application to the Bureau here.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 16⅜@16⅝c.; Lake 16⅜@16⅝c.; casting, 16⅛@16⅜c.

It is reported that the Vanderbilts have acquired large holdings in the Cleveland Electric Company.

A director of the General Electric Company says that company is now doing the largest business in its history.

The Bullock Electric Manufacturing Company of Norwood, O., has increased its capital stock from $500,000 to $3,000,000.

The United Railways & Investment Company of San Francisco is paying 4 per cent. semi-annually on its preferred.

It is estimated that Boston now has an ownership in over 100,000 shares of Brooklyn Rapid Transit stock, or nearly one-quarter of the capital stock.

The full annual report of the City Railway Company of New York is expected to be ready for publication this week. It is said that the cash balance with reserve amounts to $1,700,000.

The United Electric Securities Company of Boston has declared a regular semi-annual dividend of $3.50 per share on the preferred stock, payable November 1 to stock of record October 21. Books do not close.

The Butte (Mont.) Electric & Power Company has declared the regular quarterly dividend of 1¼ per cent. on its preferred stock, payable November 1 to stockholders of record October 27. The dividend is made payable out of surplus earnings of 1904.

The annual meeting of the stockholders of the Third Avenue Railroad Company of New York to elect directors will be held November 6. Transfer books will close October 13 for this purpose and for the distribution of a quarterly rental on October 31 and will reopen November 7.

Mayor Dunne made it perfectly plain Saturday that he is opposed to the proposed ordinance of the Chicago City Railway Company both as to its form and spirit. He issued a message giving thirteen reasons why he considered it objectionable. Some of them are comparatively trivial.

A dispatch from Columbus, O., says it is officially stated there that the Widener-Elkins Syndicate of Philadelphia has purchased the Columbus, Buckeye Lake and Newark and the Columbus, Newark & Zanesville Electric roads. The purchase of the Appleyard interurban roads has not yet been completed.

W. B. McKinley, president and general manager of the Illinois Traction Company of Champaign, Ill., announces the authorization of an increase in capital from $5,500,000 to $7,500,000. The outstanding preferred stock now amounts to $2,420,000, and the amount of common stock now outstanding is $4,318,000.

The Great Eastern Telephone Company was incorporated at Albany on Monday with a capital of $1,000,000. The Great Eastern is an independent company, and is one of a system of three companies recently incorporated. It will operate in New York City only. The canvass for subscribers will begin in ten days or two weeks.

Articles of incorporation were filed in Hartford, Conn., on Friday by the Trolley Express Company of New Haven. The company is to carry merchandise over various trolley lines. The capitalization is $100,000. All the incorporators are officials of the Consolidated Street Railway Company.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Oct. 9
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	211⅞
Manhattan Elevated Railway	165¼
Metropolitan Street Railway	127⅜
Metropolitan Securities	81¾
Ninth Avenue	197
Third Avenue	127
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	71⅞
Brooklyn City Railway	239
New Orleans Railway	36¼
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81¾
Philadelphia Traction	101
Union Traction	61⅝
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	14⅛
do. do. do. pref	57
West End Street, com	98¼
do. do. do pref	113½
Chicago.	
City Railway	192
North Chicago	83
Union Traction, com	12¼
do. do. pref.	44⅛
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	17⅛
do. pref.	59⅝
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	20⅛
do. do. pref.	24
Westinghouse, com	168
do. pref.	194⅛
General Electric	180
Boston.	
Edison Electric Illuminating	253
General Electric	180
Westinghouse Electric & Mfg., com	85½
do. do. do. pref.	100
Chicago.	
Chicago Edison	159½
National Carbon, com	62⅛
do. do. pref.	115⅛
Philadelphia.	
Electric Company of America	11⅛
Electric Storage Battery, com	83¾
do. do. do. pref.	83¼
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	138¼
Western Telephone Company	14
New England Telephone Company	136⅛
New York.	
American Telegraph & Cable Company	..
Commercial Cable Company	210¼
Mexican Telephone Company	1
New York & New Jersey Telephone Company	172¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93⅛
Chicago Telephone Company	131
MISCELLANEOUS STOCKS.	
Chicago Subway	55½
Otis Elevator Company	60
Standard Underground Cable	..
Twin City Rapid Transit	116⅛

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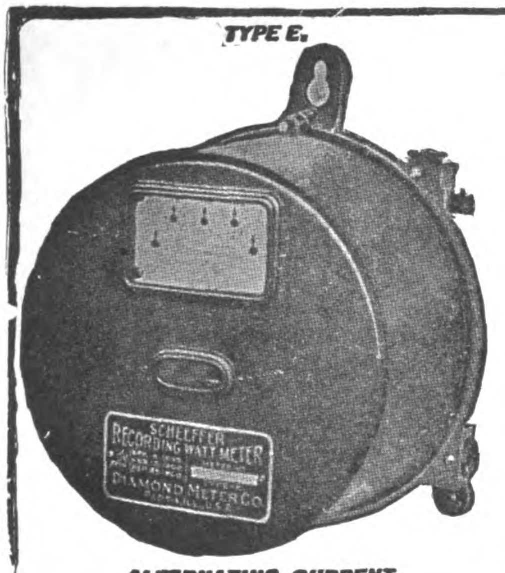

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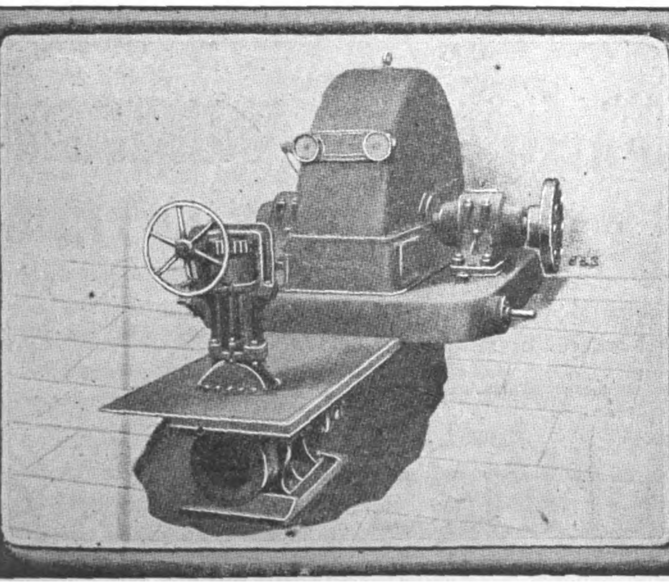

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ELECTRICITY.

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EDITORIAL NOTES.

The London Electrical Exhibition.

The exhibition for which so much preparation has been made in recent months is now in full swing at the Olympia in London and it will remain open until October 21. From personal observation our London correspondent says that it is the largest electric lighting, power and heating exhibition that has been held in England, and it is now being visited not only by tens of thousands of the general public, whose interest in the up-to-date applications of electricity for commercial and domestic purposes it was intended primarily to enlist, but already there have been deputations of municipal electrical engineers and committees from all parts of the Kingdom. They have come up to London in order to become fully acquainted with the very latest illuminating and other novelties so that they may return the better able to appeal more convincingly to the general consumer and popularize their own supply system. Many more such visits have been arranged to take place before the show closes. There are a number of popular lectures being delivered by leading electrical experts during certain evenings, these arrangements having been made by the Institution of Electrical Engineers. Demonstrations of electric cooking and heating are also being given and money prizes are to be awarded for the best exhibits in these classes.

As there are 200 exhibitors it would be useless to indicate in detail the character of all the different exhibits. The Marconi Company has an interesting show of a wireless telegraph outfit as used on a Cunard liner. The General Post Office has a historical display of old telegraphic apparatus. The Electrical Volunteers Corps have lent their South African war equipment and some interesting mementoes. Electric disinfecting apparatus, ozonizers, the Dowsing light and heat cure appliances, including the "Solarium" home equipment, which has been already described by us—are a few of the novel lines, in addition to which of course everything employed in lighting and heating installations and a good deal of battery and generating plant are shown. Of heavy plant and railway apparatus there is not much of any importance—indeed such departments are hardly represented at all.

* * *

Why Steam Roads Adopt Electricity.

If it is believed by some that sentiment. or a desire to be very modern, has made the steam roads anxious to adopt electricity as part of their motive power, they are very much mistaken. The reason why the advisory and executive forces of steam roads have moved to utilize electricity as an adjunct to their present systems is simply because the loss of traffic they would otherwise sustain made it an imperative business measure.

The local traffic of all large steam roads within a short distance of New York City will be handled in the next two years by electric means. To become duly impressed with this view of the case it is only necessary to visit the neighborhood of the New York Central above 42d street, or 33d street and 9th avenue, where the gigantic station of the Pennsylvania Railroad will be constructed. Millions of dollars have been spent already in making excavations 75 feet deep over an area equal to 15 or 20 city blocks. The cost of this real estate with the houses standing was enormous, but they have all been torn down to make way for the new electrically equipped station, electrically lit tunnels and electrically operated cars. A sum, variously estimated to reach from $40,000,000 to $60,000,000, is to be spent by the above roads respectively, in order to retain and further develop their business as carriers of the public and transporters of freight.

An enumeration of a few instances outside of New York where electricity has been formally recognized as the most economical form of energy to use over long distances will prove interesting. The longest run of this kind is from Indianapolis, Ind., to Lima, O., by way of Dayton, an interstate line nearly 200 miles in length. The average speed is about 30 miles an hour and the fare 1½ cents a mile.

The next long run by electricity is made by the Lake Shore Electric, from Cleveland to Toledo, a distance of 120 miles. The run is made at an average rate of 25 miles an hour. As regards other lines of the interurban class, follow 22 belonging to the middle West, and about five in New York State, whose lengths vary from 30 to 80 miles. The lines at present in operation in New York State are as follows: The Hudson Valley, 60 miles long; the Rochester & Eastern Rapid, 44 miles long; the International (Buffalo to Olcott), 37 miles long; the Albany & Hudson, 37 miles long, and the Fonda, Johnstown & Gloversville, 33 miles long. It makes very little difference whether these roads are disparagingly entitled only trolley roads or not; they are and have been winning their way steadily to the front. This fact may be accepted as an axiom in the new world of railroad work, which has developed in the last ten years, that wherever an electric road parallels a steam road the steam road loses money. It is just as good a passenger and freight carrier; it can run just as quickly, and it can stop at a variety of points convenient to those patronizing the road without losing much on its time schedule. This fact, hammered home, by the experience and receipts of electric roads, has been duly digested by the better class of thinkers of the steam traction systems. They have felt compelled to save themselves from the loss of a vast amount of transient and local business in the near neighborhood of large cities by adopting the weapons of their competitors. The New York Central reaches out 35 miles beyond New York City, the Pennsylvania will reach out over 50 miles from New York City—with its new electric passenger and freight service.

This last lesson in railroading was not taught by the older pupil, but by the newer. Steam roads, it seems, to save themselves are rapidly becoming electric roads.

* * *

Electricity in the Sahara Desert.

The empire of that celebrated Parisian boulevarder, who proclaimed himself King of the Sahara, is about to fall under the block of modern science. Its isolation, its mystery and its farawayness are to be things of the past. The project, once deemed unnecessary for an unnecessary ocean of sandy waste, will be carried out in all its completeness. It is going to be possible to wire messages from the interior, or coast of Algiers, to the very heart of the Sahara Desert. The telegraph line will stretch from the Mediterranean to Timbuctoo. It may not be known to the laity that a line from the Tuat Oases to the northern coast has been in operation for some time. The Tuat Oases, it may be said, were one of the stopping places of those roving pirates whose outrages upon caravans were features of history from time immemorial. "The French are just now selecting the route to the south of the Ahaggar Mountains, where the bandit Tuaregs live when at home. The Tuaregs are now quietly tending their herds, for the new masters of the Sahara have made the plunder of caravans an unprofitable profession." According to reports, the telegraph will reach southwest to the region represented by the city of Timbuctoo at which the pole line will end. The French believe the line work, the pole setting and the testing will be completed before the winter months are on. Timbuctoo is a spot where no white man dared to appear in recent times. To live in this city, an Arabic tongue, a devotion to Islam and a stained skin were the possible preservatives of life. The glacial approach of civilization has made its presence felt, in the form of its best advance guard, the telegraph. Tourists may soon be sightseeing in a region once deemed almost inaccessible and doubly dangerous through the science and enterprise of distant Europe.

The strike of the electrical workers in Berlin, Germany, is ended. A cable dispatch says that at a conference on Saturday the delegates of the workingmen voted to accept the associated companies' original offer of 5 per cent. increase in wages. The result is a complete victory for the employers. The decision of the hardware manufacturers to lock out their 20,000 workmen unless the electrical strikers returned to work was the prevailing reason for the strikers' acceptance of the terms offered to them.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Secretary H. E. Bradley informs us that the Pennsylvania State Independent Telephone Association will hold its annual convention at Pittsburg November 9 and 10.

New York City is building an incinerator for its first municipal light station, which will soon be completed. The fuel to be used will be the waste paper and rubbish gathered by the street cleaning department.

The Consolidated Railway Company, the electric holding company of the New Haven Railroad, now has 26 lines, of which 15 are constituent companies, five are leased lines and six are controlled lines. The total investments of all kinds in the Consolidated Company are $37,199,220. Including recent purchases and extensions the total mileage of the company is now 588.

The European rights for the De Forest wireless telegraph patents have been sold to a syndicate of prominent Englishmen. The capitalization of the English company is $600,000.

The Bell Telephone Company is "playing politics" in New York to keep out its independent rival. The city's Finance Department engineer thinks a franchise for the independents is worth $7,750,000—a very unjust exaction. The independent company, however, is determined to fight for its rights.

The part which electrical development has played in the growth of cities in New York State in the last five years is shown by the fact that Schenectady—the headquarters of the General Electric Company—has made a gain of 84.2 per cent. in population since 1900.

In a recent interview with a newspaper correspondent Mr. Edison said that after working out his new electric motor storage battery idea he made 14,000 cells and sent them all over the country for trial. About the result he says: "I have got back all those cells, have sifted the matter down, and I am now perfecting the model cells. By next spring I will have 400 new cells made. We will have big works to turn them out. The new cell will not cost any more than the painting and the tires of a wagon. I don't think that the cost of operation will be quite as great as the cost of horses."

LOCATION OF SMALL SWITCHES AND FUSES.

BY W. H. WAKEMAN.

In the plant which I have charge of at the present time the boiler room is lighted better than the engine room, so far as natural light is concerned, therefore electric lights are needed all day in a part of the latter, but are not required in the former. In order to save the trouble of shutting off each lamp separately, all that are in the boiler room and those in the lighter portion of the engine room were put on one circuit and a snap switch installed at a convenient point, so that a step ladder is no longer required when it is desired to shut off some of the lamps.

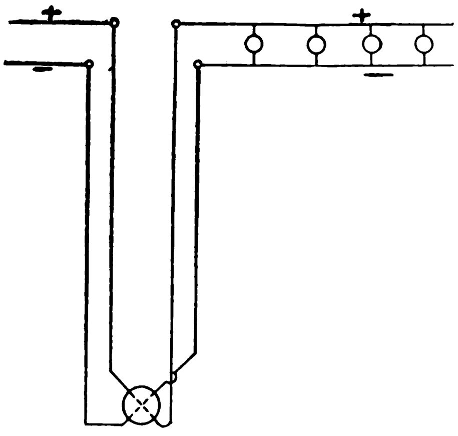

FIG. 1.

Fig. 1 illustrates this, showing how the wires were brought from the ceiling downward to a point about 5 feet from the floor, where the snap switch can be reached easily.

It will be noted that both wires are brought down, and a four point switch used, thus completely severing all connection when it is turned off. Some engineers think this unnecessary, and I have been told that my plan calls for unnecessary labor, as the plan illustrated in Fig. 2 is "just as good," and requires less labor."

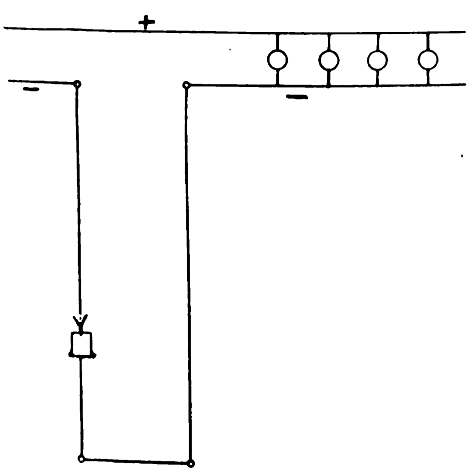

FIG. 2.

Patent medicine proprietors and others warn us against the use of spurious substitutes which are "just as good" in the estimation of others. This idea may be applied to electrical work with profit, provided it is done in an intelligent way, for where a certain plan for wiring rooms has proved sufficient, it may not be wise to change it.

This calls for a two point switch located in the negative line, for when it is thrown out the circuit is broken, consequently all lamps on that line go out. The same effect will be secured if the switch is placed in the positive line, for it breaks the circuit just the same. As a rule the engineer of a plant does not know which wire is positive, because there are so very few cases in which it is necessary to know this, except where arc lamps are used, consequently it is well to remember that a single point lever switch, or a two point snap switch may be located in either the positive or the negative lines, as it will then shut off all lamps on that line.

There are some reasons, however, why it is better to sever the connection in both wires, as the following incidents plainly show.

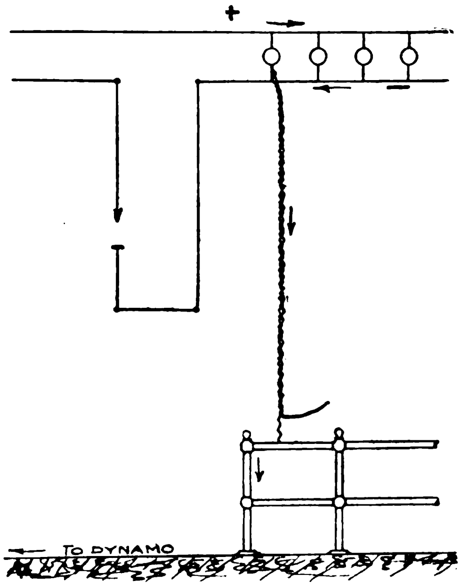

FIG. 3.

Fig. 3 illustrates a switch in the negative wire of a circuit, and a lamp cord hanging down from a rosette in the usual way. The negative wire of this lamp cord came in contact with a brass railing as shown, causing all lamps to light, much to the engineer's surprise. Current came over the positive wire, passed through the lamps in the usual way, returned as shown by the arrow, went down to the railing and from thence traveled through earth to the dynamo.

In this case there are but three lamps shown beyond the rosette carrying the lamp cord, as these are enough to show the principle involved. No harm was done in this case because all current coming to the railing had to pass through the lamps, and they acted as a check to the rapid flow of current.

Fig. 4 illustrates the same plant, but here the positive wire is in contact with the railing, hence a much larger quantity of electricity passed, because there was nothing to hinder it, consequently a hole was burned in the heavy brass pipe, which disfigured it, but a valuable lesson was learned, as the experience showed that a dangerous quantity of electricity may pass over a circuit of which the earth forms a part, when the negative wire of the metallic circuit is disconnected.

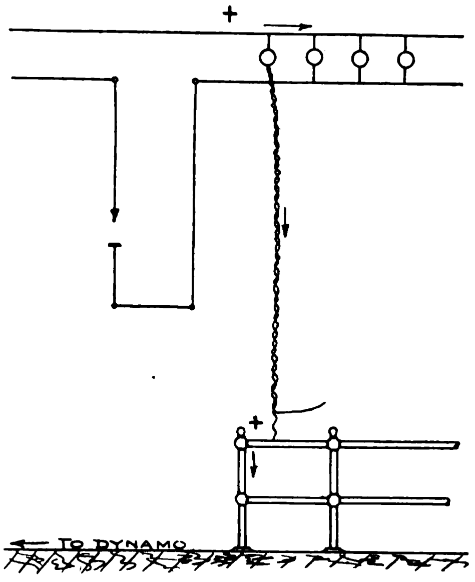

FIG. 4.

Fig. 5 illustrates an accident somewhat similar to the foregoing, although it resulted from a different cause. Potential between the two main wires was carried at 550 volts, and as it was desirable to use 110 volt lamps, five of them were connected in series. The lower lamp was used on a long cord to provide light on the top of a battery of boilers whenever it was required for repair work, etc. While screwing up a nut the engineer caught this cord between his wrench and a steam pipe, which quickly burned off

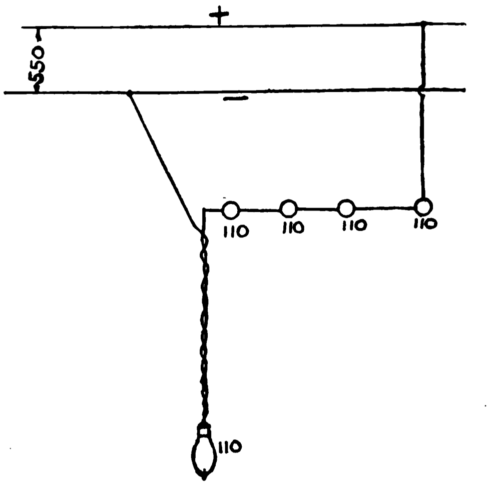

FIG. 5.

the insulation. Evidently this brought the negative wire in contact with the iron pipe, and as a heavy current was passing at that instant enough of it was diverted from its natural course to "burn a hole" in the pipe, using a common expression, or in other words to melt a small piece of the metal.

My reason for believing that it came from the negative line is that the current coming through five lamps is not enough to accomplish the result mentioned, but other connections at other points were sufficient to transmit the required amount from the positive to the negative wire.

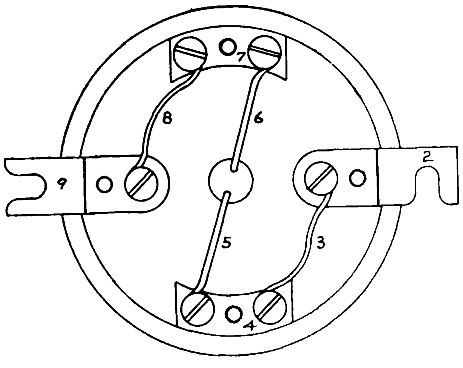

FIG. 6.

Fig. 6 represents a rosette for connection between the positive and negative wires of an ordinary circuit. It may be explained as follows. Connection may be made with the positive wire 2 causing current to pass over the fuse 3 to the cleat 4 to which the positive wire of the lamp cord 5 is connected. As current goes down 5 and returns over 6 it passes to the cleat 7 over the fuse 8 and the connection 9 to the negative wire of the line.

This is a safe form of connection, because it is impossible to draw more current by a short circuit on the lamp cord, than either of these fuses will carry, and as they should always be very light, one or both of them will melt before the main fuse for that branch line fails. It is possible to melt both of them, provided the short circuit is made between the two wires composing the lamp cord, but if it is made by connecting one wire to a brass rail, or some other piece of metal, only one fuse will melt, as due consideration of Figs. 3 and 4 plainly show.

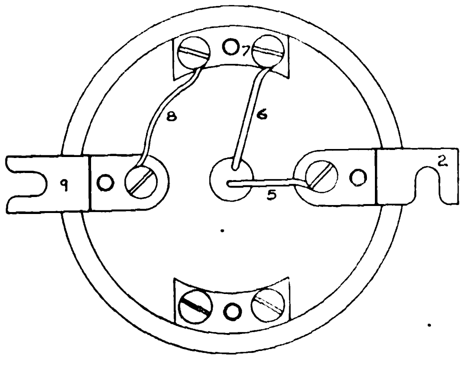

FIG. 7

Fig. 7 illustrates a rosette containing but one fuse. Current may come from the positive wire over the connection 2, and as there is no fuse 3 to connect it to the cleat 4, it goes directly to the positive wire of lamp cord 5, and after passing the lamp it returns over the negative wire 6, goes to the cleat 7 and the fuse 8 which carries it to the connection 9, and thence to the negative wire of the branch circuit.

To illustrate the possible mischief due to such a connection it is only necessary to mention the system installed in one building forming part of my present plant. It is a three-wire system to junction boxes on each floor, and from these boxes two wire branch circuits are carried wherever lights are wanted. Suppose there are eight lamps connected to a branch circuit, and the positive wire is connected without a fuse as at 5, Fig. 7. The positive wire of the lamp cord is brought into contact with something forming a good connection to earth.

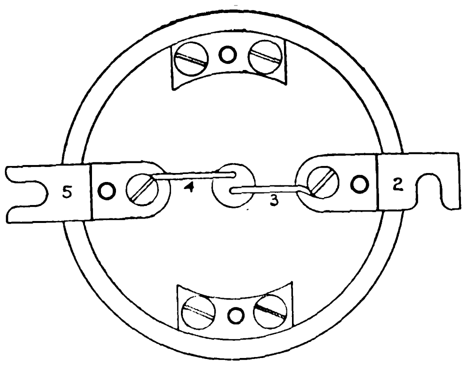

FIG. 8.

Where the branch line leaves the main line there is a 10 ampere fuse plug on each wire connection, consequently the short circuit mentioned melts the 10 ampere fuse and puts out eight lamps. Searching for the defective connection shows that all fuses in eight rosettes are in good order, therefore the cause of trouble remains a mystery. Replacing the melted fuse plug restores the branch line to usefulness, but if this rosette had contained two fuses like Fig. 6, only one lamp would have gone out, thus locating the trouble at once.

Fig. 8 illustrates a rosette without fuses, thus causing current to come in over the positive connection 2, pass directly down the lamp cord wire 3 past the lamp, coming up 4 and going over 5 to the negative wire. It is legal to make this kind of connection, as the law no longer requires fuses for each lamp, but it causes all lamps on a given branch circuit to fail, as the result of a short circuit, when otherwise only one lamp would be affected.

Perhaps some reader will claim that short circuits of this kind are not liable to occur, but more than 10 years' service as engineer in an educational institution, has taught me that hundreds of mischief-loving boys can invent many things that are not on the programme to spoil the best laid plans. Furthermore ignorant workmen in a mill or factory seem to have a special gift for inventing plans for short circuits, breaking wires, etc., thus causing the engineer in charge unnecessary work and worry.

UP-TO-DATE ELECTRICAL POWER DISTRIBUTION.*

BY R. L. GAMLEN.

It is now about 28 years since electricity was first generated commercially. With Mr. J. W. Swan's discovery of the carbon filament the incandescent lamp offered at once a solution of the problem of internal lighting. Not long afterwards the first early attempts were made at electric traction.

Developments soon came which not only made the working for lighting better, but also made the supply of power a possibility.

The immense value of a power load became at once apparent to supply engineers, as here was a chance of increasing their working hours of utility, and they at once started to put their works in order so as to profit as far as possible by this new source of revenue and to cater for it to the best of their ability. They have succeeded to a great extent, but the old system had its limits, and great power companies have sprung up to deal with the question. Not as a patchwork of old methods, but starting *de novo*, and on lines designed for the particular work, with none of the old unnecessary drawbacks, but with all experience at their back.

A demand has come for: (1) Electricity to be supplied more cheaply than it can be made by individuals; (2) a supply so certain that, but for a veritable "act of God," no cessation can occur; and (3) a supply so regular that the angular velocity of the motors is more constant than the best results before obtained.

In the records of electricity concerns a capital of $500 per kw. of plant is no uncommon figure; but a quarter of this figure should be obtained by a power company. The factors controlling the choice of plant are: Absolute immunity from breakdown, perfect regulation, small fuel consumption, ease of working, and consequently a low wages bill.

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*Abstract of paper read before the British Institution of Mining Engineers.

The power companies have in nearly all cases laid out their schemes on somewhat similar lines. Three-phase distribution has been adopted, at a pressure of about 10,000 volts. The current has been generated at high pressure, generally by means of turbines running with high vacuum and high superheat. The water-tube boiler has been universally adopted, and one or another form of mechanical stoker used.

In the case of Lancashire, the first station has been placed between the River Irwell and the railway, upon the far side of which is a coal mine from which supplies can be obtained. The site is convenient, inasmuch as there is an ample water supply for condensing purposes; the railway being situated above the boiler house, the coal is conveyed by gravity into the bunkers, and thence it is fed on to chain-grate stokers, operated by electric motors. The first boiler house is divided into two banks of three boilers. The two banks are each capable of evaporating 60,000 pounds of water per hour. The boilers feed on to one common ring of pipes, and the turbines are fed from the same, so that two turbines are fed from one bank. One bank of boilers then, with its chimney and two turbines, constitutes 1 unit. It is proposed to make extensions in like manner, except that instead of one bank of boilers feeding two turbines, each bank will feed one machine of larger capacity. The water-tube boiler is used on account of the very great steaming capacity for a given floor space, and of its great powers of responding to forcing. It is, of course, highly important when dealing with large generators to arrange that sufficient boiler capacity can be available without the steam having to travel through vast lengths of main. By placing the boilers at right angles to the turbines, very satisfactory arrangements can be arrived at.

The turbines revolving at 1,000 r.p.m. look, of course, exceedingly small for the amount of work they do; indeed, the amount of power that can be obtained on a certain floor space by their means seems nearly incredible to the engineer who has been accustomed to work with the older slow-speed engines. The turbine lends itself particularly well for condensing; in the case of the Curtis turbine there is no exhaust pipe, the condenser being coupled direct to the engine. This can be done in two ways: either by placing the condenser side by side with the turbine, or underneath, either arrangement being very compact and convenient. In Lancashire the air-pump is placed beyond the condenser, so that the three form really one plant. The result is that an engine room only 96 feet long and 32 feet wide, is needed to house four sets of 2,000 kw. each, or 8,000 kw. in all; whereas in nearly all previous cases as large a building has been necessary for an engine of 800 hp. and less. When the extensions take place, this ratio of plant and buildings will diminish again, as the diameter of the 5,000 kw. set is comparatively little larger than that of the 2,000 kw. plant. In the case of the Curtis combination, the dynamo is placed on the same spindle as the driving buckets and vertically above them. Owing to the high speed of rotation the electrical generator is of very small proportions, the diameter being only some 7 feet; whereas an ordinary direct-coupled set, at about 150 r.p.m., would be somewhere about 25 to 30 feet high, and, of course, much more expensive.

The three-phase current generated at the high pressure of 10,000 volts is carried to the switchboards. A great deal depends upon the design of this section. The operation must be easy, there must be no danger from fire, and the whole must be safe. The system known as remote control has been employed almost universally. The danger of switchboard trouble is overcome; no mains of large power are on the operating board, so that there is nothing to fire; and even if any little accident did happen it would not damage the main cables, as they are not near, and the supply would not suffer. Here, again, the simplicity is such that one man can look after and control what would before have needed perhaps five or six men.

By being able to spread over large areas, great varieties of load can be catered for, and these different requirements balance out one with another, giving a very constant load at the station. It is likely that the number of units produced by a power company when attaining to moderate size for each kilowatt demanded should reach 2½ times that of the ordinary town supply—that is, the load factor of an ordinary combined lighting and power supply will be high at 18 per cent., while that of the power company should reach 45 per cent., and this greatly reduces all the annual capital charges.

There is great prejudice in this country against the use of overhead mains, but this is gradually being overcome, and already great advances are being made. In the original scheme, the whole of the Lancashire mains were intended to run underground; already it has been arranged that some 10 miles of route shall be overhead. By this means, expensive insulation is saved, and also the excavation and reinstatement of the roads, greatly reducing the cost of the transmission system. Further reduction is obtained also, as often the cross-country overhead route is much shorter than if the routes had to be followed. The main roads are laid in duplicate, and are planned to go through the most likely districts for supply.

Arrangements are made with the various local authorities for the supply in their areas. In some cases, the current is sold to the authorities, and they distribute to the small consumers at low pressure; in other cases, the company act more or less as agents for them and look after the distribution. In all cases, large power users are served direct from the high-tension mains. In most cases the current used is three-phase, as this is most suitable for almost all purposes; the reduction apparatus in this case has no moving parts and requires no attendance, so that even in this extra stage to that needed by the ordinary supply concern no extra expense is incurred.

The following points indicate the general scheme of the lay-out of the power company, and show where the differences occur between it and the ordinary town supply: (1) The power company chooses its site near the fuel and the water; (2) the power company spreads out over a large area, and caters for a large long hours' load, consequently it can start on large lines with large units of plant, the capital cost of plant per horse-power diminishing as the size increases; (3) the load factor of the power company should reach 45 per cent., and (4) all the working expenses of the power company per unit are extremely small on account of the size and convenience of the units. On the other hand: (1) The town supply is located by the area of supply, and it seldom can be placed near water, and hardly ever near a coal-pit; (2) the town supply has a constricted area, and can only work in small units, and small units are more costly per horse power than large ones; (3) a good mixed town supply can hardly ever have a better load factor than 18 per cent.; and (4) the wages bill of a town supply is generally a large factor of the total costs.

The preceding recited points show that power companies hope to be able to supply electricity far more cheaply than town undertakings, and the future will show whether their ideas are based on fact or on fiction.

LIGHT, HEAT AND POWER PRINCIPLES.—IV.

BY NEWTON HARRISON, E. E.

Light and Lamp Efficiencies.—The amount of light obtainable from a horse power or kilowatt of electrical energy is not limited by theory, as it is by practice. The ordinary 16 candle power lamp, is only a stepping stone to better forms of illumination, as far as power consumption is concerned. It is not to be forgotten that the incandescent lamp, which now takes from 3 to 4 watts per candle power, has been built to take only 1 watt per cp., though under such circumstances its durability becomes a matter of great question. The following table illustrates the amount of light produced by 1 horse power and 1 kilowatt of electricity by lamps consuming various wattages per candle power:

TABLE OF LIGHT PER POWER UNIT.

Watts per candle power in lamp.	Candle power per kilowatt.	Candle power per horse power.
5	200.0	149.2
4.5	222.2	166.0
4.0	250.0	186.5
3.5	285.7	213.0
3.0	333.33	248.6
2.5	400.00	294.4
2.0	500.00	373.0
1.5	666.66	497.3
1.0	1,000.00	746.0
.5	2,000.00	1,492.0

Short Life with High Efficiency.—The carbon will not last, if pushed to too great a temperature in giving light. The use of only 1 watt per candle power in lamp construction represents so great a risk that no guarantees of any description are given with such lamps by the factory. Only lamps using rare oxide filaments are expected to have so great an efficiency, and still possess durability. The economic side of the question is best presented by means of another table, in which the number of lamps rated at 16 candle power, which might be used per horse power or kilowatt on this basis are given:

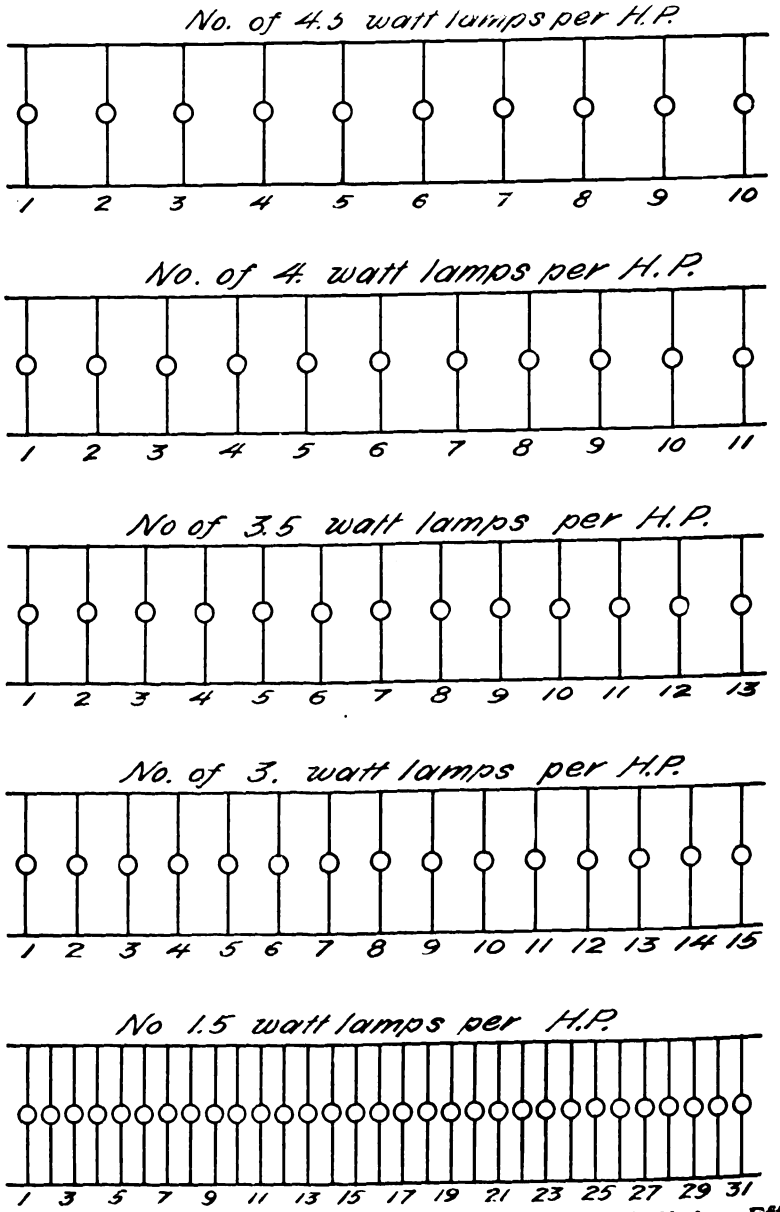
Number of 16 cp. lamps per horse power.	Number of 16 cp. lamps per kilowatt.	Watts per candle power.
9.32	12.50	5.0
*10.40	14.00	4.5
*11.60	15.62	4.0
*13.30	17.8	3.5
*15.50	20.83	3.0
18.40	25.00	2.5
23.31	31.25	2.0
31.00	42.00	1.5
47.00	62.50	1.0
93.25	125.00	.5

The figures marked with a star are those which lie within the range of general electric light practice; representing the use of lamps, whose watt consumption per candle power varies from 3 to 4.5. Along the line of figures giving 1.5 watts per candle power may be found, under the heading of lamps per horse power and per kilowatt respectively: 31 and 42. A lamp which in electric light practice takes only 1.5 watts per candle power will be the means of increasing the available number of 16 candle power lamps of the regular type, from 15 or 20 to 30 or 40. It is not a difficult matter to imagine the advantages of this to a station whose capacity is tested to the limit. A station, for instance, in which the generators can only supply 10,000 16 cp. lamps under ordinary conditions; but which actually has its capacity increased by the use of more efficient lamps to the extent of being able to double its lighting as far as the number of lamps are concerned. From the economic standpoint already referred to, the station income is by such means so greatly increased that the engineering side of it becomes rapidly transformed into a financial advantage of large dimensions. To further accentuate the benefits arising through the use of efficient lamps, the case of a 1,000 light station is given, in which the increase in lamps is tabulated as the watts per candle power are diminished:

CAPACITY OF A 1,000 16-CP. STATION UNDER DIFFERENT CONDITIONS.

Supplying power to	Lamps.
3.5 watt lamps.	1,000
3.0 " "	1,166
2.5 " "	1,400
2.0 " "	1,750
1.5 " "	2,333
1.0 " "	3,500

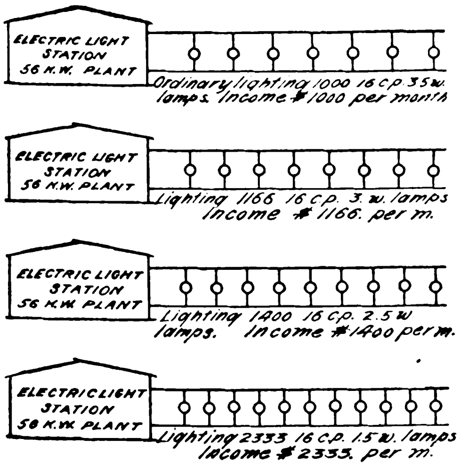
The reason why so many different efforts have been made to produce a lamp so much more efficient than the one in general use is largely found in the above figures. A station supplying power to light 1,000 lamps could, by the introduction of a lamp whose efficiency is represented by any of the figures given, increase its lighting capacity 50, 100, 200 or 300 per cent.



Increasing Capacity of 1 HP. to Give Light with Lamps of Higher Efficiency.

Another Feature of Higher Lamp Efficiency.—The cost of a lamp, whose renewal is more frequent because of its higher efficiency, also calls for consideration. If a higher efficiency lamp burns only half the time of a lower efficiency lamp, but during that time takes only half the power of the second lamp, the question arising is this : In comparing the value of the power saved with the value of the lamp, is there an advantage or a loss? For instance, if a lamp costs one dollar, but it saves one dollar's worth of electricity, is there any gain in the experiment? The answer is best given in the form which takes into consideration the fact that the station has been able to double its capacity as a source of electricity for lighting. The earning power of the plant has been doubled because it can double its customers with the additional expense of only doubling its lighting facilities outside. If the cost of the lamp is prohibitive, because its replacing is too expensive, then the advantage of a higher efficiency is lost.

The advantages are best set forth, however, in a table showing the increase in the income of a plant on the suppositious basis of about $1 a month per 16 cp. lamp:


ELECTRIC LIGHT STATION 56 K.W. PLANT
Ordinary lighting 1000 16 c.p. 3.5 w. lamps. Income $1000 per month
ELECTRIC LIGHT STATION 56 K.W. PLANT
Lighting 1166 16 c.p. 3. w. lamps Income $1166. per m.
ELECTRIC LIGHT STATION 56 K.W. PLANT
Lighting 1400 16 c.p. 2.5 w lamps. Income $1400 per m.
ELECTRIC LIGHT STATION 56 K.W. PLANT
Lighting 2333 16 c.p. 1.5 w. lamps Income $2333. per m.

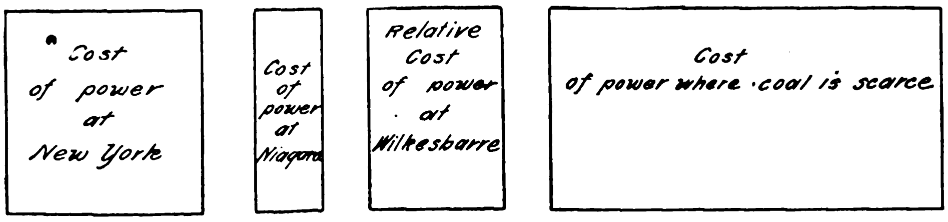
Increased Capacity of a Plant with Low Watt Lamps.

Increase in income of a 1,000 3.5-watt lamp plant. Dollars increase per month.	Number of lamps of higher efficiencies.
$1,000	1,000 3.5-watt lamp.
1,166	1,166 3.0 ‘‘ ‘‘
1,400	1,400 2.5 ‘‘ ‘‘
1,750	1,750 2.0 ‘‘ ‘‘
2,333	2,333 1.5 ‘‘ ‘‘
3,500	3,500 1.0 ‘‘ ‘‘

Any form of engineering or finance that can make a given condition become more productive is unquestionably superior to that originally prevailing. In the application of electricity to certain purposes, like electric light or power, a guidance in doing things is often best obtained by reference to the ultimate purpose of the enterprise. In electric lighting particularly the two important features which present themselves are, first, the cost of the power, and second, the amount of light from a given amount of power.

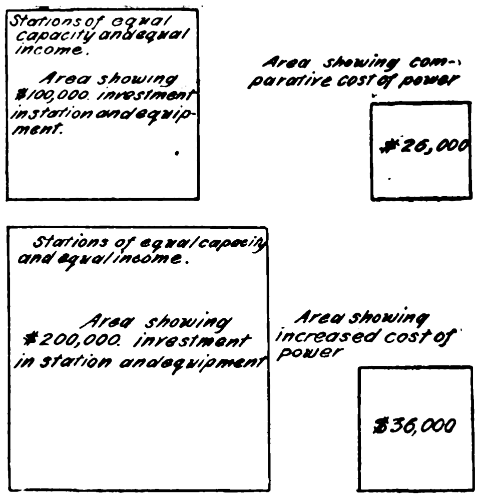
Cost of Power.—The cost of fuel is only one part of the cost of power. The more expensive the machine in which fuel is burnt the more expensive is the act of consuming it. But the expensiveness of a machine is always proportional to its economy, in such fields of engineering as relate to electric light and power work. In other words, the manufacturers of very economical devices believe that the saving due to the devices exploited should be partly divided. For this reason highly economical forms of apparatus due to special inventive talent, that necessitated costly experimenting to produce, are also expensive. A high grade boiler, engine or generator calls for an investment larger than one of inferior grade. In electric lighting the best of machinery is generally employed, because the saving qualities of certain classes of apparatus are such that the annual gain by their use far outweighs the additional expenditure necessary by their purchase. Burning coal in a high grade boiler means the combustion of fuel in a device, whose original cost is great enough to make it and the other elements of the station, constitute a heavy investment; the interest which must be earned to make this investment a financial success is earned by the coal when its energy is transformed into heat, steam power, electricity and electric light and power. The cost of power depends, therefore, upon the two items—of cost of fuel, and extent of the investment for machinery, real estate, conductors, lamps, etc. An illustration of this fact can be drawn from the following table covering various degrees of investment:

Cost of fuel per annum.	Cost of station.	Interest on investment at 6 per cent.	Cost of fuel and interest.
$10,000	$100,000	$6,000	$16,000
‘‘	200,000	12,000	22,000
20,000	300,000	18,000	38,000
‘‘	400,000	24,000	44,000
30,000	500,000	30,000	60,000
‘‘	600,000	36,000	66,000
50,000	700,000	42,000	92,000
‘‘	800,000	48,000	98,000
100,000	900,000	54,000	154,000
‘‘	1,000,000	60,000	160,000


Cost of power at New York
Cost of power at Niagara
Relative Cost of power at Wilkesbarre
Cost of power where coal is scarce

Relative Effects of Locality Upon Cost of Power.

The table given is not statistical, neither is it based upon calculations derived from data relating to electric light practice. It simply illustrates the idea of the increasing cost of power, though the fuel does not increase in price per ton, with the increased heaviness of the investment for machinery, real estate, conductors, etc. If, for instance, the cost of one station is $100,000, as compared with the cost of another station of $200,000, and both produce the same amount of power, require the same number of employes and have the same number of customers for light and power—then with equal efficiencies, the power of one station costs much more than the power of the other to produce. This can be illustrated in the following estimate, in which $10,000 worth of coal is supposed to be burnt up in each per annum :


Stations of equal capacity and equal income.
Area showing $100,000. investment in station and equipment.
Area showing comparative cost of power
$26,000
Stations of equal capacity and equal income.
Area showing $200,000. investment in station and equipment
Area showing increased cost of power
$36,000

How a Heavy Investment Increases the Cost of Power Relatively per Unit.

Investment of $100,000.		Investment of $200,000.	
Interest..	$6,000	Interest..	$12,000
Fuel.....	10,000	Fuel......	10,000
Labor....	10,000	Labor....	10,000
Total...	$26,000	Total....	$32,000

As all the expenditure each year as well as each month, week and day, is for the purpose of producing light and power at the other end, it is quite evident that the spending of large sums in the installation and equipment will mean a greater cost for power, unless it is recognized that the best of judgment was used in making the expenditures, and that they were made for indispensable elements of the plant.

Cost of Power in Various Localities.—Localities have a great influence upon the cost of power per horse or per kilowatt. At Niagara Falls, neither the ground nor the power itself is a source of heavy expense. In New York City, the same amount of power would mean large investments for costly real estate, for coal and for conduits for the subterranean conductors. In the neighborhood of coal mines, where fuel is cheaper because of the saving in freight, power would be cheaper. The cost of power is in many respects largely proportional to the investment required to produce it.

SOME RECENT DEVELOPMENTS IN SUBMARINE SIGNALING.*

BY ALFRED GRADENWITZ.

Sending sound signals through the air has long been the only means of insuring the safety of ships in fogs, but the limited range of such signals, and the extreme variability in the sound transmission through the atmospheric air, due to fluctuations in the density and temperature of the medium, as well as to the disturbing effects of wind and the sound-damping influence of snow, considerably reduce the efficiency of this method. There is further the liability of the signal to be disturbed by echoes, and the impossibility of accurately locating the origin of a sound reaching the ear. The majority of the terrible disasters to ships which occur every year may be said to be due to the vessels losing their course in the fog.

Now, as water is not subject to the same variable influences as air, while it is a more efficient sound conductor than the latter, submarine signals must obviously be far more reliable than those sent through the air. Sea water has practically the same density at any depth, and the velocity of sound in this medium is four times as great as in air; whereas in the latter sound travels about 1,100 feet a second, the rate in water is 4,712 feet, or almost one mile a second. On the other hand, the velocity of the tidal currents in the ocean is considerably less than the speed of the wind above its surface, which, in the case of storms, will frequently reach 30 miles per hour.

Furthermore, there is below the surface of the sea practically no noise liable to interfere with the sound signals, experience having shown these to be heard and located equally well in the most violent storm as in perfectly calm weather.

A highly important invention, enabling submarine signals to be used with a view to increasing the safety of ships, was made six years ago by Arthur J. Mundy, of Boston. The idea of the "submarine telephone," as his apparatus may be termed, was impressed upon him by the loud report of a stone falling into the water while his head was beneath the surface. Not being a practical inventor, he induced the late Prof. Elisha Gray to co-operate with him in developing the idea into a practical system. On account of his discoveries in telephony Prof. Gray was exceptionally competent for carrying out this difficult work. He made the sounds convert themselves into electrical impulses by relays, and when this problem was solved the working out of practical details proved comparatively easy. Shortly before his death Prof. Gray was able to make a test before a company of scientists and prominent business men, whose report was highly in favor of his system. Among these men were Prof. Elihu Thomson and Henry M. Whitney. With the assistance of eminent engineers and scientists, Mr. Mundy succeeded, after Prof. Gray's death, in carrying the invention through to its present perfect condition.

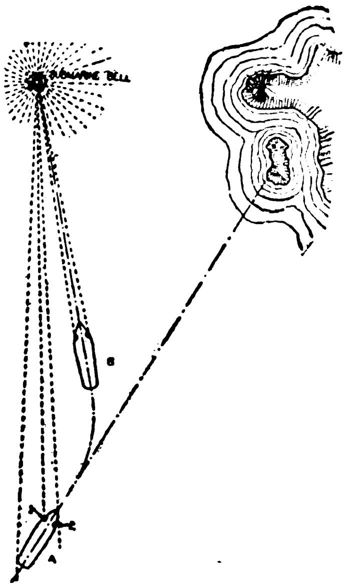


Fig. 1.

The apparatus, which is doubtless destined to prove a most valuable aid to mariners in their struggle against fog, is simple in construction, and can be fitted into vessels without any great expense and without any damage to the shell. It comprises two essential parts, viz., a special type of immersed bell, serving to produce the sound beneath the water, and the receivers, by means of which the sound arriving from a distance can be perceived and its direction ascertained.

The two receiving apparatus (Fig. 2) are fitted into the hull below the water-line to the starboard and port respectively. Each of the two is a galvanized iron tank, the upper cover of which is domed, while a metallic diaphragm in the interior is set vibrating by the incoming sound waves so as alternately to close and interrupt an electric circuit. The motion of the diaphragm is transmitted by means of the circuit to the receiver in the pilot house (Fig. 3) in exactly the same way as in the telephone, the whole outfit being nothing else than an application of the telephone principle.

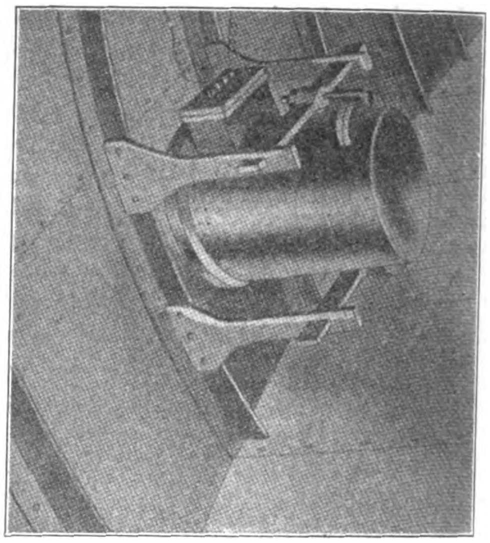


Fig. 2—Receiver Case in Hold of Ship

The working of the receiving apparatus will be readily understood from Fig. 1, their use being as simple as their construction.

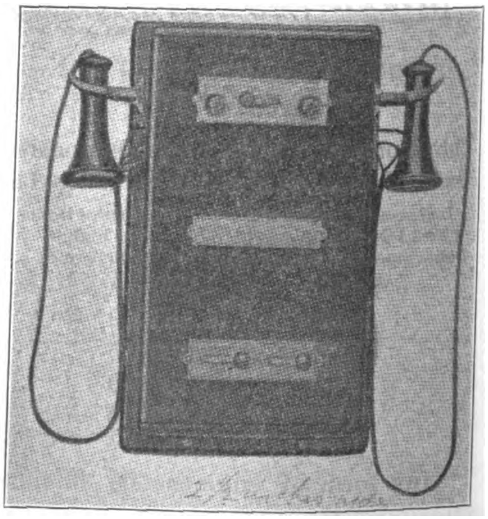


Fig. 3.—Receiving Box in Pilot House.

The vessel at A being on a dangerous course will perceive the sound from the remote submarine bell more loudly through the receiver 1 on the port bow, i.e., on the side turned towards the bell. As the vessel alters her course in the way indicated in the figure, when she is in the position B, the two receivers will give a sound of the same intensity, and she will have gained the direction of the submarine signal, thus avoiding the imminent danger of running ashore. If, on the other hand, the pilot at the beginning had heard more distinctly the sound through the receiver 2 he would have been advised of his vessel keeping the proper course.

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* From the "Electrical Review," London.

Boston Harbor now has a submarine signal bell not only on Boston lightship but also a similar bell anchored on Harding's ledge, off Point Allerton. Another submarine bell will soon be placed in the middle of the ship channel opposite Boston light, being sunk deep enough to allow all vessels to go directly over it. Sailing masters can then lay a direct course for this bell in thick weather, whereas at present they have to calculate their position by the bell on Boston lightship.

The system of signaling now in use along this coast consists in ringing signal bells on all the lightships. These bells toll out the numbers of the different lightships, 54 for Boston, 73 for Pollock Rip shoals, 66 for Nantucket shoals, etc. There is an interval of two seconds after each beat of the bell, four seconds between numbers, and six seconds before the code is repeated. These bells are rung by steam pressure and work automatically. In clear weather there is no need for sounding the warning bells, which are rung only when the weather thickens and the foghorns are started.

Vessels coming up from New York by the Vineyard in foggy or squally weather listen first for the bell on Vineyard Sound lightship, tolling out 41. Getting their bearings here, they have a good chance for laying a proper course for Pollock Rip shoals, where another guiding bell may be heard.

The sailing master nearing a port or dangerous reef where a lightship is anchored takes down a receiver and moves a lever first to one side and then to the other. The side through which the sound comes indicates that the bell is on that side of the ship. Sound will not travel around a corner under water; it moves in straight lines. Or if, like light, it be reflected, it is so weak as to be readily distinguishable from the sound coming from the same object in a direct line.

Fig. 1 explains how a sailing master can guide a ship by the sound of a submarine bell.

It has been found that the exact position of the bell can be determined in this way to within half a point. As the mariner's compass is divided into 32 points, 8 points marking the angle from east to south, for instance, it will be understood how close to the true direction half a point means.

Another device, for enabling the lookout to stand in front of the pilot house and still listen for the bell, is a flexible speaking-tube running from the telephone on the side of the house. The magnets within the telephone make it necessary to keep it some distance away from the compass.

When this mechanism is understood it is easy to see how readily it can be used for many other purposes than listening for a lightship bell. The screw of an approaching steamer can be heard two or three miles off, for the sensitive microphone in the ship's hold picks up and repeats every sound in the water.

Taking advantage of these facts, the Navy Department at Washington proposes to use the submarine telephone first of all for communication with submarine boats. It has requested the Submarine Signal Company to build a special apparatus for sending messages. This is now being done in the Signal Company's laboratory and workshops, and the instrument is called a multiple sounder. One instrument which is being experimented with has an alphabetical keyboard much like a typewriter. Pressing a key causes a set of hammers to beat on a diaphragm the Morse telegraphic sign for each letter. Anyone who can operate a typewriter can in this way send a submarine message.

A special apparatus somewhat like a stock ticker would enable messages to be picked up on a submarine boat and turned out on a printed tape. In the same way messages could be sent from the submarine boat and received on a shore station, or on the flagship of a fleet. A still simpler way of sending messages, without any special apparatus of this sort, is by attaching a striking gong or bell to the side of a ship and tapping out a certain code. This tapper can be worked by hand, by steam, or by a pneumatic device. Anyone knowing the code can pick up such messages at a distance of from 5 to 12 miles, through a receiving telephone. It is proposed to have a general code for use by all mariners in communicating with lightships, lighthouses, or with all other vessels having submarine telephones. The Naval Department will naturally have a secret code, perhaps the same as is now used in telegraphing.

The first experiment in sending messages in this way took place last summer at Newport. The yacht Chipeta, equipped with sending apparatus, tapped out messages which were received and answered by the submarine boats, Porpoise and Shark, while under water. The submarines had no apparatus for replying. The crude method of striking a hammer against the steel sides of the boat was used, but, it proved effective. A sending apparatus has been put upon a Government tug at Newport, and experiments are now being made by the commandant of the torpedo station there, with a view to introducing this system as a regular part of the submarine boat service. The Dutch Government has made application to the Boston inventors for this same message-sending device to be used on its submarine boats.

United States naval authorities are now looking to the submarine telephone for communicating between the ships of a fleet while in action. It is feared that wireless telegraphy cannot be relied upon then, on account of the concussion of the big guns throwing the delicate wireless coherers out of order. The flag signals are sometimes unseen, owing to smoke or fog arising and dispersing a fleet. So it appears that the submarine telephone will become an exceedingly important part of a navy signal system.

Boston ships were the first to take up the submarine signal invention, even before it was a proved success. The Metropolitan line, plying between Boston and New York, was one of the pioneers. For a year or more the boats of this line have been making their courses into Boston Harbor, and round Cape Cod, guided by the signal bells along this dangerous piece of coast. Other ships, not equipped with telephones, sometimes lie in wait in Vineyard Haven, and, upon seeing a Metropolitan liner, weigh anchor, and steam after her in order to made a safe passage.

The Philadelphia boats have already been equipped with the system; the Merchants and Miners' line boats use it. The North German Lloyd is equipping its entire line, and the Hamburg-American line is also installing it. The Canadian Pacific ships and the Allan liners have likewise installed submarine telephones, while Mr. J. P. Morgan's steam yacht Corsair was the first large steam yacht to adopt it.

Besides being a safeguard for large and costly ships, it is also available for fishing smacks. Two Gloucester fishing boats, the Arkona and Mary L. E. Hardy, now each carry a small and simple submarine signaling outfit. This consists of a pair of ordinary receivers attached by wire ropes to two metal bells containing microphones which are let down on either side of the vessel or dory. There is also a light cell which can be let down in the water from a dory and signals tapped upon it.

WRINKLES.[*]

EDITED BY H. C. ABELL.

Method of Bracing Wooden Tanks of Storage Battery Cells that Have Rotted Out at the Corners.

Large porcelain insulators, such as are used for indoor wiring, were driven in between cells where wood had just started, and if necessary wedged in place by a thin wooden wedge. Tanks braced in this manner are insulated from each other, as would not be the case if wooden wedges alone had been used.

CLEVELAND ELECTRIC ILLUMINATING CO.

Storage Battery Test of Materials for Protecting Copper 'Bus Work in Battery Rooms.

Strips of sheet copper about 0.75 inch wide and 6 inches long were coated with protecting material to be tested and suspended in a bath of sulphuric acid (1.2000 specific gravity) so that they were only partially immersed in the acid. A portion of the upper part of the strip was purposely left bare to observe the effect of acid fumes.

After remaining in the acid for one month the strips were removed and examined.

Their condition was as follows:

1. Strips coated with vaseline; showed no signs of corrosion or sulphating. Coating in as good condition as when first applied.

2. Strip coated with tar; was in the second-best condition of any strip, as no sulphate was formed on that part of the strip not immersed in the acid, but one edge of the immersed portion was sulphated about one-third of its length.

3. Strip coated with shellac; was third best; one edge, however, had peeled off, allowing the acid to attack copper. A portion of the unprotected copper about one-half inch wide was badly sulphated.

4. Strip coated with paraffin; most of the immersed portion of the strip was not sulphated, but from one-half inch below the surface of the acid to the top of the strip was badly sulphated.

5. Strip coated with graphite paint gave results similar to paraffin.

6. Strip coated with heavy, viscous petroleum cylinder oil; badly sulphated entire length.

Vaseline was the only substance that stood the test, but is not entirely satisfactory as a protective on account of its pasty nature.

Experiments were carried out with mixtures of vaseline and paraffin, the latter substance acting as a hardening material. It was found that if over 30 per cent. by weight of paraffin was used the coating cracked slightly and did not adhere properly to the copper 'Bus work was painted with a mixture of 20 per cent. paraffin and 80 per cent. by weight of vaseline, and after three months' use the coating is apparently as good as ever. Dust and moisture can be removed by a soft cloth without injuring coating.

CLEVELAND ELECTRIC ILLUMINATING CO.

Recharging Flashlight Batteries.

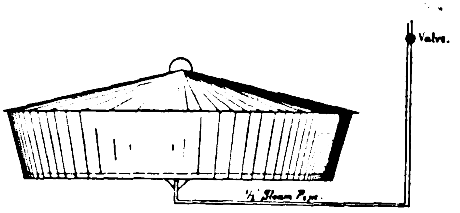
In our meter-readers' room are terminals of the 220-volt direct current, with three 50 cp., 110 volt incandescent lamps in series for recharging batteries.

By placing the battery across these terminals for one or two minutes it is then ready for service again. This prolongs the useful life of the battery at least 100 per cent., in this way cutting down the maintenance on flashlights to a considerable extent.

H. S. RUSSELL, Denver, Col.

Soiled-Waste Cleaner.

I think the drawing of a soiled-waste cleaning arrangement, which I have found very good in my plant, will explain itself.



WASTE CLEANER AND CONNECTION.

We use a galvanized tub to which is connected a half-inch steam pipe, and when the dirty waste is put in we mix with it a box of pearline; after it has boiled for a few hours the waste is taken out and run through a clothes wringer, which puts it in very good shape for use. I do not know whether this is a novel scheme or not, but I offer it for what it is worth.

A. R. SMITH, Demopolis, Ala.

Cleaning Waste and Rags.

We separate out all the oil and a portion of the dirt in the waste and rags by means of a centrifugal washing machine. A machine of this type can soon be made to pay for itself, which we have found out from actual use.

G. H. CUSHMAN, San Antonio, Tex.

WHAT TO DO WITH OUR BOYS.

In an article on the best system of training for engineers, "Engineering" of London prescribes the following course: Taking a bright, strong lad about 16, who wishes to become an engineer; he should go straight from school into the workshops of a medium-sized general engineering works, making, if possible, electrical plant as well as general machinery, as it is necessary nowadays for every engineer to have some knowledge of electricity.

An arrangement should also be made by which the lad does not go to the works on Mondays, but attends instead morning and afternoon or evening classes in engineering at a technical college, thus doing his practical and theoretical work side by side, to the advantage of both. While in the shops the pupil should be encouraged to use his notebook, and to ascertain the labor cost of doing work, also to discover the reasons why the theoretical best forms of machinery are modified in actual practice; and it should surely not be too much to ask that the works manager, in the interests of the future generation of engineers, should give up one or two hours per month to a sort of informal examination of the pupils under his charge, thus ascertaining their progress, and giving them some encouragement to persevere in their work and studies.

The writer is of opinion that the workshop course should follow the course of machinery through the works—that is, the pupil should start in the pattern shop and go on to the foundry, the machine shop and the fitting or erecting room in rotation. A year in each of these four shops should be sufficient to give the pupil a thorough grounding in the practical principles of his profession, and if he shows promise at the end of this time, he should be placed in the drawing office for a couple of years.

At the end of these two years he should go into the accountants' department, and be kept at purely commercial clerical work for another year, after which he might go into the estimating department for two years more, and, provided always that the lad has shown enough ability to justify his being given these opportunities, at the age of 25 we have a young engineer admirably adapted for a post as assistant manager, or even as manager, provided again that he is possessed of the power of ruling others, which is, of course, a physical characteristic, and has little or nothing to do with training.

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[*] Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

Electric Vehicles Show Progress.

For the purpose of proving that the generally accepted theory that electric automobiles are of little value for long-distance work, and that their range is limited to city streets, two leading manufacturers of this class of vehicle in France have recently conducted a series of tests over the roads from Paris to Trouville, a distance of 130 miles. The results were a surprise, and indicate a great advancement in the construction of batteries. The cars that were used were heavy town vehicles, but they succeeded in making speeds that on stretches of 50 miles averaged from 16.7 to 28 miles an hour.

The first test was made by M. Vedrine with two cars, a three-seated cab weighing 3,476 pounds and a landau weighing 3,960 pounds. The cab carried three passengers and the laudau four. The start was made at St. Germain. For the first 52 kilometers the cab made a speed of 24.2 miles an hour. At Evreux both cars were recharged and the run was completed in 5 hours, 35 minutes and 13 seconds after the start, the average speed being 20.8 miles over good but hilly roads. The landau averaged 16.7 miles an hour.

The success of M. Vedrine induced M. Krieger, another manufacturer, to test two of his cars over the same road. His cars were a closed coupe weighing 3,498 pounds, and an open landaulet weighing 3,938 pounds. Both recharged at Evreux, having made the run to that town at a speed averaging 20.8 miles an hour. The same average was maintained for the remainder of the trip, the total running trip being 4 hours, 50 minutes and 13 seconds for the coupe and 4 hours, 22 minutes and 8 seconds for the laudaulet. M. Vedrine started the same day with a four-seated closed coupe and ran from St. Germain to Trouville without recharging at an average speed of 18 miles an hour.

Merit Marks a Success.

So effective has the "Brown System of Discipline," employed in public schools and colleges, proved with the 12,000 employes of the Brooklyn Rapid Transit Company, that it has been installed as a permanent feature of the company's policy toward its employes.

The system provides for a series of merit and demerit marks which are accorded each of the motormen, conductors and switchmen for good work or bad. Sixty demerit marks constitute a dismissal. Good behavior for three months entitles the employe to five merit marks, which cuts down his demerit marks an equal number. Impudence, carelessness and intemperance are some of the sources of demerits.

Proposals Invited.

The Bureau of Supplies and Accounts of the Navy Department at Washington is inviting sealed proposals until October 31 for furnishing Eastern navy yards with the following supplies: Schedule 181, incandescent lamps; schedule 182, electric soldering irons. Prospective bidders can obtain blank proposals and detailed information of the above by applying to the Bureau at Washington, or to the Navy Pay Office in New York for Eastern Yards.

New York Electrical Society.

The New York Electrical Society will hold its opening meeting at the Edison Station, 27th street near 6th avenue, on Monday evening, October 23. Mr. Peter Cooper Hewitt will lecture on "Electrical Reactions of Gases."

Armour Institute of Technology.

The Armour Institute of Technology, 23d and Armour avenues, Chicago, is offering evening classes for the session of 1905–1906 in mechanical, electrical, telephone, civil, chemical and fire-protection engineering, with drawing, practical shop work and mathematics.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED OCT. 10, 1905.

Electric Railways and Appliances.

801,226. Trolley for Electric-Railway Vehicles. Harry P. Davis, Pittsburg, and Christian Aalborg, Wilkinsburg, Pa., assignors to the Westinghouse Electric & Manufacturing Company. Filed March 6, 1905.

801,335. Trolley. Eugene J. Parker, Providence, R. I. Filed Dec. 23, 1904.

801,363. Motorman's Valve. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Filed April 27, 1903.

801,602. Electric Locomotive. Lincoln Moss, New York City, assignor to the Robins Conveying Belt Company, same place. Filed Feb. 2, 1904.

801,631. Apparatus for Controlling the Operation of Railway-Switches. Charles C. Anthony, Philadelphia, Pa. Filed March 6, 1905.

801,718. Trolley-Harp. Charles L. Hooper, Rochester, N. Y. Filed Dec. 27, 1904.

801,733. Automatic Block-Signal System. Ross Logsdon and Elza S. Stotts, Perry, Ia., assignors of one-third to Bayard T. Linley, Des Moines, Ia. Filed Jan. 18, 1904.

Electric Lights and Appliances.

801,261. Electric Lighting System. Granville E. Palmer, Boston, Mass., assignor of one-half to Charles B. Price and Frank S. Price, same place. Filed Nov. 6, 1903.

801,364. Safety Device for Lamp-Signals. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 19, 1904.

801,637. Electric-Arc Lamp. Emile Batault, Geneva, Switzerland. Filed July 19, 1902. Renewed March 1, 1904.

801,664. Adjustable Electric-Lamp Holder. Henry F Holtmann, Indianapolis, Ind. Filed Nov. 23, 1904.

Electrical Machinery and Apparatus.

801,214. System of Motor Control. Frank E. Case, Schenectady, N.Y., assignor to the General Electric Company. Filed July 2, 1904.

801,224. Automatic Electric-Motor Starter. William M. Cummiskey, Newark, N. J. Filed July 20, 1904.

801,230. Emergency and Vacuum-Breaking Valve Mechanism. William L. R. Emmet, Schenectady, N. Y., assignor to the General Electric Company. Filed April 5, 1904.

801,238-239. Means for Controlling Circuit-Breakers and Control Apparatus. George H. Hill, Schenectady, N. Y., assignor to the General Electric Company. Filed Aug. 8, 1904, and March 1, 1905.

801,243. Electric Measuring Instrument. Frank Holden, Rugby, Eng., assignor to the General Electric Company. Filed Jan. 2, 1904.

801,245. Electrical Controller. Henry D. James, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Feb. 27, 1905.

801,250. Supporting-Clamp for Electric Conductors. James R. Kearney, Topeka, Kan. Filed Dec. 15, 1904.

801,255. Armature Cross Connection for Electrical Machines. Chester B. Mills, Wilmerding, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Oct. 20, 1904.

801,285. Electric Controller. Robert Wellens, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Dec. 19, 1904.

801,288. Quick-Break Electric Switch. Herbert C. Wirt, Schenectady, N. Y., assignor to the General Electric Company. Filed March 5, 1902.

801,355. Self-Propelled Vehicle and Method of Controlling the Same. Ernest J. Berg, Schenectady, N. Y., assignor to the General Electric Company. Filed April 20, 1904.

801,357. Governing Mechanism for Turbines. John G. Callan, Lynn, Mass., assignor to the General Electric Company, Filed March 30, 1905.

801,399. Governing Mechanism for Turbines. Richard H. Rice, Swampscott, Mass., assignor to the General Electric Company. Filed April 1, 1905.

801,419. Electric Measuring Instrument. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed Feb. 15, 1905.

801,441. Electric Switch-Throwing Device. Louis H. Coxe, Philadelphia, Pa. Filed Nov. 12, 1904.

801,487. Controller. Leonard A. Tirrill, Lynn, Mass., assignor to the General Electric Company. Filed June 3, 1904.

801,497. Electric-Meter Bearing. James J. Wood, Fort Wayne, Ind. Filed Nov. 8, 1904.

801,536. Face-Plate for Electric Switches. Norman Marshall, Newton, Mass. Filed Jan. 19, 1905.

801,588-589. Transformer Cut-Out. John P. Hetherington, Logansport, Ind. Filed Dec. 15, 1904, Jan. 4, 1905

801,784. Automatic Electric Switch. William S. Guthrie, Terrell, Tex. Filed Nov. 29, 1904.

Telephones and Telephone Apparatus

801,231. Index Attachment for Telephones. Fred E. Farmer, Alliance, O. Filed April 28, 1905.

801,308. Lock for Automatic Telephone-Switch Shafts. John Erickson, Chicago, Ill., assignor to the Automatic Electric Company. Filed Dec. 31, 1904.

801,778-779-780. Telephone System and Apparatus and Telephonic Apparatus. Charles E. Egan, Chicago, Ill., assignor to the Egan Electric & Telephone Manufacturing Company, Petersburg, Ill. Original application filed Sept. 29, 1904. Divided and last application filed Aug. 16, 1905.

Miscellaneous.

801,380. Apparatus for Electrostatic Separation of Substances of Diverse Electric Susceptibilities. Charles H. Huff, Brockton, Mass. Filed Aug. 6, 1904.

801,509. Signal System. Valentin Chisholm, Rockland, Me. Filed April 14, 1905.

801,578. Range-Finder. Bradley A. Fiske, New York City, assignor to the Western Electric Company. Filed Nov. 25, 1902.

801,774. Conduit for Electric Cables or Conductors. Thomas E. Devonshire, London, Eng. Filed Nov. 5, 1904.

801,800. Signaling Through Submarine and Like Cables. Oliver J. Lodge, Birmingham, and Alexander Muirhead, London, Eng. Original application filed Oct. 3, 1904. Divided and this application filed April 25, 1905.

801,823. Automobile. Ernst J. Berg, Schenectady, N.Y., assignor to the General Electric Company. Original application filed April 20, 1904. Divided and this application filed May 22, 1905.

Reissue.

12,393. Leading-In Wire for Incandescent Electric Lamps. Thomas A. Edison, Llewellyn Park, N. J., assignor to the Edison Electric Light Company. Filed July 12, 1905, Original No. 444,530, dated Jan 13, 1891.

THE TELEPHONE WORLD.

Big Plans for New Company.

Thomas W. Finucane, president of the United States Independent Telephone Company, arrived in New York City last week and took up his headquarters at No. 31 Liberty street. In an interview he said:

" For six months engineers have been mapping out the territory in which the Independent company will begin work. Fifty switchboards and 15 exchange buildings have been located, leases for which will be signed when the engineers have overseen the laying of cables and telephone wires.

" Not one contract will be solicited until we are ready to install our telephones. We will then give New York service in one-half the time it now takes to form a connection. We have simply profited by the experience of the corporation which controls the telephone system in New York. The rates will be materially lower. Our lines are down to Peekskill and we will be in New York without loss of time.

"Application has been made to the Empire City Subway Company for service, which we demand under our franchise originally granted to the Mercantile Electric Company, and absorbed by the New York Independent Telephone Company.

" There is nothing private or hidden about the United States Independent Telephone Company. It was organized for the express and particular purpose of making money for its stockholders and for giving to the citizens of New York and other cities in this country the best telephone service that they ever knew anything about and at a much lower rate than they are now paying. We are going to do both. We have the money to keep up our end. When the New York plant is in operation the system will extend from here to Utah."

Ericsson Company Will Build Factories.

The Ericsson Telephone Company, the largest manufacturers of telephones and telephone supplies in Europe, is preparing to establish a telephone system in Mexico.

The company also intends to erect large workshops at Buffalo, N. Y., the power for which will be obtained from Niagara Falls.

The first annual meeting of the stockholders of the Sioux City, Ia., Telephone Company was lately held. The old board of directors was re-elected by the 40 stockholders, which comprised about four-fifths of the total number of persons holding shares in the company. The board consists of T. A. Thompson, E. W. Rice, D. S. Lewis, F. L. Eaton, W. P. Manley, Howard S. Baker and George C. Scott. President Thompson and Secretary Scott made their annual reports and addressed the stockholders as to the prospects of the company, which both held to be very bright. Mr. Thompson reported that 1,600 'phones had been installed.

A recently organized concern, known as the Austinburg, O., Telephone Company, is backed by F. M. Houghtaling, Tracy D. Herrick, G. H. Webb, M. B. Andrews and W. W. Barnes.

An Independent telephone line is being built between Richland and Sheridan, Pa., and touches a number of thriving towns.

Severe Terms for Independent Company.

Independent telephone operations in New York City received a setback Friday when Controller Grout, presented to the Board of Estimate a special report of Engineer Harry P. Nichol, of the Finance Department, on the value of the franchise sought by the Atlantic Telephone Company. Under the terms as fixed by Mr. Nichol, the company would have to pay the city $7,750,000 in 25 years as a minimum for the privilege of entering the local field to compete with the New York Telephone Company.

These terms are regarded by the Independent companies as unnecessarily onerous, being much more severe than the terms imposed upon the New York Company. The Independent company is willing to furnish telephones at half the rate charged by the Bell Company.

The New York Telephone Company pays the city practically nothing for its franchise. It is taxed on its real estate and on its franchise as real estate, under the franchise tax law. The Independent telephone companies, however, will be taxed likewise under the State statutes. For its franchise rental the Bell company should pay the city through its ownership of the Empire City Subway; but its payments through this source have been held up for years, with the result that the city has been obliged to begin what seems to be interminable litigation without being able to get the company to pay anything.

The Missouri & Kansas Telephone Company has closed a contract for an exchange at Colwich, Kan. The exchange will be put in by a company composed of Colwich business men, and will be operated in connection with the Missouri & Kansas service. This will give the wholesalers of Wichita direct telephone connection with the Colwich business men. A reduced rate has also been put into effect between Colwich and Wichita.

The telephone war at Foley, Minn., in which the Northwestern Telephone Company, the Twin City Telephone Company, the village council and citizens in general have been more or less involved, was ended at a meeting of the village board lately, when it was unanimously voted to grant a franchise to the Northwestern Telephone Company. This franchise carries with it the privileges of the streets.

The directors of the Great Eastern Telephone Company, lately incorporated in Albany, N.Y., are William H. Schack, Eugene P. Brock, Elias J. Seach, Egbert A. Reynolds, William Reynolds, of New York City, and Stephen B. Conger, of Brooklyn.

A new telephone company has been organized at Springtown, Pa., with H. S. Funk as president; H. H. Funk, secretary, and J. S. Weierbach, treasurer, to connect upper Bucks County towns.

The Decatur County Mutual Telephone Company of Leon, Ia., was lately organized with a capital of $10,000 by E. J. Harney and others.

The Sunset Telephone Company's wires are being put underground in Palo Alto, Cal.

Independent Companies Merge in Southwestern Kansas.

A charter has been granted the Citizens' Home Telephone Company, a corporation with a capitalization of $500,000, organized for the purpose of taking over and consolidating all the Independent telephone companies in Southwestern Kansas. The incorporators are James Plottner and George Yeager, of Kansas City; Fred Perkins and D. J. Romino, of Oswego; George Spangle, of Chetopa, and C. H. Kimball and F. H. Brown, of Parsons. The general offices will be located in Parsons.

The companies to be consolidated are: Pittsburg Home Telephone Company, Galena Home Telephone Company, exchanges at Galena, Weir City and Scammon; Labette County Telephone Company, exchanges at Oswego, Chetopa, Altamont, Mound Valley, Edna and Bartlett, and the Parsons Home Telephone Company.

The consolidated companies have a total of 3,000 'phones, and over 400 miles of toll lines. A copper circuit will be put in from Pittsburg, connecting with the St. Louis and Kinloch long distance lines by way of Parsons to Cherryvale, where it will connect with the Kansas City Home Telephone Company's long distance lines.

The Home Telephone Company of Los Angeles, Cal., has bought a site for its new building, which will be erected soon, and in which will be installed the new automatic apparatus which will displace the manual now in use at the main office, so that the entire system will in the near future be completely automatic.

The Long Distance Telephone Company of Los Angeles, Cal., has opened new offices in the Currier Building and begun the installation of new switchboards for increased facilities. It is installing a new 25 pair cable between Los Angeles and Pasadena, the new lines are working to Riverside and the San Diego lines are nearing completion.

President Zimman, of the Omaha, Neb., city council, announces that he will introduce an ordinance demanding a "substantial" reduction in the charges for telephones by the Nebraska Telephone Company. He says he has assurances that it will be passed by the council.

A special meeting of the stockholders of the New York & New Jersey Telephone Company will be held in Brooklyn, N. Y., October 25 to vote on a proposition to increase the capital stock from $15,000,000 to $50,000,000. The authorized stock was increased in March, 1901, from $8,000,000 to $15,000,000, and all except $1,220,900 has been issued.

The Ticonderoga Home Telephone Company was incorporated last week with a capital of $25,000. The directors are J. A. McLaughlin, Putnam; R. N. Clemens, Dresden; D. C. Bascom, of Ticonderoga, N. Y.

M. A. Joy, of Terrell, Tex., has made application to that city council for a franchise to operate a telephone company. A committee has been appointed by the council to consider the application.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Appleton, Wis.—A co-operative electric plant is being projected in this city by some of Menasha's business men.

Charles City, Ia.—A deal was lately made whereby the electric light company passed from H. V. Fussell & Co. to F. O. Martin, of Floyd, and A. L. Dodd, of this city. The last-named gentlemen recently purchased the water power at Floyd, and will use it to furnish power for the light plant at this city, transmitting the electricity some six miles by means of a feed wire.

Coalville, Utah.—The city council has approved the plans and specifications for the power house for the electric light plant.

Columbus, Ga.—A resolution recently offered by Alderman Newman was adopted by the city council and a committee appointed to investigate the cost of establishing a municipal lighting plant here.

Columbus, O.—While plans have not yet been definitely decided upon, it is probable that the directors of the new First National Bank will soon ask for prices on a complete independent electric lighting plant for their new building.

Conroe, Tex.—The Southern Pine & Cypress Company of Houston will establish a planing mill and electric lighting plant.

Crawfordsville, Ind.—J. F. Davies has been awarded the contract for repairing the Crawfordsville municipal electric lighting plant, for $8,538.

Defiance, O.—At a recent meeting of the city council a resolution was introduced declaring it necessary to bond the city in the sum of $50,000 for the purpose of erecting and maintaining an electric lighting and gas plant.

Fayetteville, N. C.—This city is arranging to make extensions and improvements to its electric light plant.

Highlands, N. J.—An election will be held November 8 to vote on the question of issuing $25,000 in bonds for the installation of water and an electric light system.

Kimball, Wis.—The Superior Construction Company of Houghton has been awarded a contract to build and install an electric lighting plant for the Kimball & Clark Company.

Lawrence, Kan.—The Lawrence Electric Light Company has been granted a franchise to furnish electricity for light and power throughout this city.

Morehead, Ky.—The Morehead Electric Light Company has been organized by citizens here. The poles are being placed in position, and all arrangements made for installing an electric light plant.

Newport, R. I.—A matter of interest which recently came up before the city council was the authorizing of the committee on street lighting to ask for proposals for bids for the installation and erection of a municipal electric lighting plant, this being mentioned, as the present contract for lighting the streets by electricity expires on November 15.

Oakdale, Ky.—The American Electric Lighting Company, a concern recently incorporated and of which A. F. Steber is president, has secured a contract with the board of trustees of this place to furnish lights for a term of five years.

Rockmart, Ga.—This city contemplates issuing bonds for the construction of an electric light plant. Address the mayor.

Russell, O.—Messrs. Fullerton and Wilson, of Greenup, have been awarded a franchise to erect an electric light plant here for the purpose of supplying domestic and street lighting.

Van Buren, Ark.—The Van Buren Electric Light & Power Company has been incorporated with a capital of $25,000, by John E. Powers and Sidney A. Pernot.

Warsaw, Mo.—This town has voted affirmatively on the proposed $6,000 bond issue for erection of an electric light plant. The town clerk may be addressed.

West Terre Haute, Ind.—The town board in adjourned session granted a franchise to the West Terre Haute Light & Power Company. The company is composed of Claude Erwin and Samuel C. Stimson. The franchise provides for the construction and operation of an electric light and power plant.

STREET RAILWAYS.

Anderson, S. C.—An application for a charter for a trolley line to Ensley has been made. The capital stock of the company is $100,000 and incorporators R. Frank Smith and Joseph J. Long.

Barrington, Ill.—A new trolley line is projected from Chicago through Cook, Lake and McHenry Counties, the object being to connect Lake Geneva with Chicago.

Brillion, Wis.—O. C. Henke has returned from New York in the interests of the Fox River Valley Electric Railway, and reports that all obstacles have been overcome and that the construction of the line at an early date is assured.

Canton, O.—The power house of the Canton-Akron Electric Railway Company was lately destroyed by fire, causing a loss of about $45,000.

Crete, Ill.—Arthur Burns, who is interested in the Chicago & Kankakee line, has been here to procure the right of way for the new electric road which will be built through this city this fall.

Danville, Pa.—At a recent meeting of the council application was made by the West Branch Electric Street Railway Company for the right of way over certain streets in this city.

Findlay, O.—The Sandusky, Fremont & Tiffin Traction Company has been incorporated with a capital of $100,000. Charles Thompson and W. H. Gilcher are the incorporators.

Frederick, Md.—The sale of the Frederick & Middleton Electric Railway to the Baltimore & Frederick Electric Railroad Company was lately consummated.

Muncie, Ind.—George F. McCulloch has stated that an electric line is to be built from Kansas City to Topeka.—The Delaware County commissioners have granted a franchise to the Indianapolis, Newcastle & Toledo Electric Railway Company, which proposes to build a traction line from Newcastle to this city.

Nelsonville, O.—The Nelsonville, Athens & Glouster Traction Company has been incorporated with a capital of $10,000. The incorporators are L. F. Carpenter and J. P. Reynolds.

Newark, N. J.—President Underwood of the Erie, recently said: "A committee is considering the electrical equipment of the line. At first this equipment will be in suburban territory. It has been demonstrated that electrical service is all right there. Arrangements are being made for the installation of the most modern and efficient railway signal service in the market."

Omaha, Neb.—The proposed electric line from this city to Griswold may enter Council Bluffs.

Owingsville, Ky.—The Olympian Springs Company, composed of Lexington capitalists, has about decided to build an electric railway from the springs to this town.

Pekin, Ill.—The village board of Tremont has granted to the Bloomington, Pekin & Peoria Interurban Railway Company a 50-year franchise to operate and maintain an electric railway in and through that village.

Plainfield, Ill.—An electric line is to be constructed connecting this place with Naperville, Wheaton and other towns in Du Page County and giving a direct electric railway connection from the capital of Will County to the capital of Du Page County.

San Francisco, Cal.—A railroad deal affecting this city and San Jose and the intervening peninsula has been perfected here. L. E. Hanchette has bought for $500,000 in cash the Santa Clara Interurban Railroad Company. He has also purchased for $800,000 the San Jose & Santa Clara Railway Company. Of the purchase price he has paid down $50,000 in cash to bind the bargain.

Wabash, Ind.—With a capital of $50,000 the Wabash & Northern Traction Company has been incorporated by J. A. Barry and Lincoln Guynn.

Wheeling, W. Va.—A force of surveyors for the proposed Belmont Electric Railway is working over the streets of this city, taking measurement for the new line in order to get affairs in shape and ask for bids for its construction.

POWER PLANTS.

Bellingham, Wash.—Stone & Webster, of Boston, whose purchase of the Nooksack Falls power plant from the Bellingham Bay Improvement Company, was announced a short time ago, will immediately spend $200,000 in completing the plant to a capacity of 2,000 hp., with ultimate plans to invest $1,000,000 and guarantee 25,000 hp.

Hartford City, Ind.—Architect Weatherhogg, of Ft. Wayne, is preparing plans for the erection of a new power plant for the Wayne Paper Mill in this city.

Provo City, Utah.—L. L. Nunn, of this place, manager of the Telluride Power Company, is contemplating the erection of a big power plant on the Duchesne for the purpose of furnishing heat and light for Park City, Salt Lake City, Bingham, Mercur, Eureka, Price and other places in the State.

Rome, Ga.—A large electric power plant is to be built on the banks of the Etowah River between this city and Cartersville The capital stock of the company is $400,000. R. L. West, of Atlanta, is one of the promoters.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 16⅜@16⅝c.; Lake 16⅜@16⅝c.; casting, 16⅛@16⅜c.

At a directors' meeting of the Crocker-Wheeler Company, at Ampere, N. J., the regular quarterly dividend of 1¼ per cent. was declared.

The directors of the Coney Island & Brooklyn Railroad Company have been re-elected. They will meet to-day (October 18) to elect officers.

The Metropolitan Street Railway Company of New York has applied to list on the Stock Exchange $1,284,000 additional refunding 4 per cent. bonds of 2002.

The Grand Rapids (Mich.) Railway Company has declared the regular quarterly dividend of 1¼ per cent. on its preferred stock, payable November 1 to holders of record October 18.

A financial writer says "the stock market just now very much resembles an electric fan. It is refreshing and entertaining to look at, but if you get too close to it you are liable to get hurt."

The Milwaukee Electric Railway & Light Company has declared the regular quarterly dividend of 1½ per cent. on its preferred stock, payable October 21. Books close October 20 and reopen November 1.

The twentieth annual report of the Edison Electric Illuminating Company of Boston shows a surplus of the interest and dividends of $71,415, against $77,408 in the previous year. There was, however, an increase in interest and dividends of nearly $100,000 last year.

The Hudson Street Railroad Company filed articles of incorporation Monday in the county clerk's office at Jersey City. The capital stock is $3,000,000 and the object of the company, as given in the papers, is to construct and operate street railway lines in Hudson County, N. J. The new lines are to tap the tunnels to New York.

The Pacific Gas & Electric Company has been chartered in San Francisco with a capital stock of $30,000,000, consisting of $10,000,000 six per cent. cumulative preferred and $20,000,000 common. This is the company formed by N. W. Halsey & Co. to take over the California Gas & Electric Corporation and the San Francisco Gas & Electric Company.

The stockholders of the Hartford (Conn.) Electric Light Company have accepted the charter amendments authorized at the last session of the Legislature, allowing an increase in the company's bonds and capital stock. It was voted to increase the capital from $1,600,000 to $1,800,000 by the issue of $200,000 new stock at par to present shareholders. This is at the rate of one new share for each eight shares of stock now outstanding, so that eight rights will stand for one new share.

The annual report of the New York City Railway Company, for the fiscal year ended June 30, 1905, shows the actual earnings on the $52,000,000 Metropolitan Street Railway Company stock to have been 16-10 per cent., compared with 4 3-10 per cent. earned the previous year. The gross income for the last fiscal year was $9,061,304. Total deductions for interest, rentals, etc., exclusive of the 7 per cent. dividend guaranteed on Metropolitan Street Railway stock, amounted to $8,218,246, leaving a surplus, before the payment of the 7 per cent. Metropolitan dividend of $843,058, or 16-10 per cent. on the stock.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price Oct. 16
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	215
Manhattan Elevated Railway	166¼
Metropolitan Street Railway	125⅞
Metropolitan Securities	80⅞
Ninth Avenue	197
Third Avenue	125
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	71⅞
Brooklyn City Railway	239
New Orleans Railway	36¼
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81¾
Philadelphia Traction	100⅛
Union Traction	63⅛
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	14⅛
do. do. do. pref	57
West End Street, com	98¼
do. do. do pref	113½
Chicago.	
City Railway	192
North Chicago	83
Union Traction, com	12
do. do. pref.	42

ELECTRIC MANUFACTURING COMPANIES' STOCKS.

Name.	Closing price Oct. 16
New York City.	
Allis-Chalmers, com	17⅝
do. pref.	60⅜
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	16½
do. do. pref.	22
Westinghouse, com	168
do. pref.	194½
General Electric	180
Boston.	
Edison Electric Illuminating	246½
General Electric	180
Westinghouse Electric & Mfg., com	85½
do. do. do. pref.	100
Chicago.	
Chicago Edison	160
National Carbon, com	62½
do. do. pref.	115½
Philadelphia.	
Electric Company of America	11⅛
Electric Storage Battery, com	83¾
do. do. do. pref.	83¾

TELEPHONE AND TELEGRAPH STOCKS.

Name.	Closing price Oct. 16
Boston.	
American Telephone & Telegraph Company	138¼
Western Telephone Company	14
New England Telephone Company	188
New York.	
American Telegraph & Cable Company	..
Commercial Cable Company	210¼
Mexican Telephone Company	1
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93½
Chicago Telephone Company	131

MISCELLANEOUS STOCKS.

Name.	Closing price Oct. 16
Chicago Subway	52
Otis Elevator Company	60
Standard Underground Cable	..
Twin City Rapid Transit	116½

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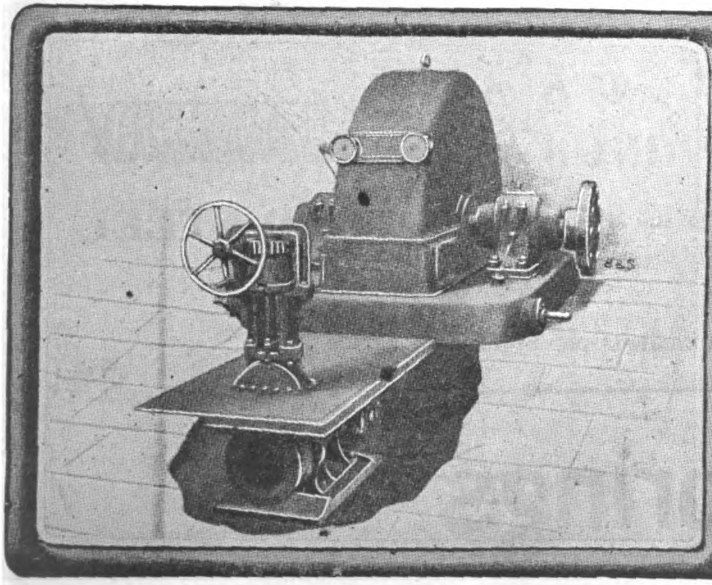
PEORIA, ILL. U.S.A.

DIRECT CURRENT.



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ELECTRICITY.

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THE TRADE SUPPLIED BY
THE AMERICAN NEWS COMPANY.

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EDITORIAL NOTES.

Elevator Development.

Skyscrapers are the proofs that may be offered to show the degree of success attained in elevator construction. It is quite evident that these most noted architectural features of New York are the result of conclusions in the field of elevator construction which indicate the safety, speed, economy and popularity of the modern electric elevator.

Survival of the fittest is the only adequate expression to use in explaining why the electric elevator has taken the most prominent place of all in the development of this class of apparatus. The steam elevator and hydraulic elevator were at one time the only ones in use, but gradually their position was usurped by the electric, which is now considered, and worthily so, the type of elevator in every way best suited to the equipment of a tall building, a hotel or an apartment house. The application of the motor to the raising of a weighted mass between guides at first sight seems a simple enough problem. But the discouraging features which appear are not entirely those which relate to the lifting of the car. They relate to the lowering of it, and for that reason, because that rate must not be too rapid on account of the human freight on board, the problem has become accentuated. Means by which the descent, however rapid, is checked, and the final stop made in a gentle manner, represent one of the triumphs of electric elevator construction. In an hydraulic device the simple regulation of the flow of water under pressure will delay the movement of the large piston rod projecting from the cylinder, controlled by the water. But in an electric elevator it was necessary to utilize more scientific principles in order to avoid the rude shock of concussion at the bottom of the shaft. The problem of lifting the car offered only one difficulty, which was that of holding it securely when the power was off. Either the lifting cable governed this, by being itself checked, or the car was held by means of brakes. The former, as may be noted, was adjudged the best, and in consequence the necessity for performing this operation gradually, though within a very short period of time, was as necessary in stopping as in starting. Without entering into the technicalities relating to this phase of elevator design and construction, the fact to be observed is, that all of these things have been splendidly accomplished. In consequence safety, speed, economy and popularity have been the final and admitted features of this indispensable form of machinery.

The readiness with which business men are willing to occupy the fifteenth or twentieth floor of a skyscraper, a dangerous altitude at the best, is because they rely upon the elevator for rapid exit. Let it be believed that the elevators of large buildings are defective, and the exodus from such would be in volume and rapidity one of the traditions of New York. The electrical engineer has not only given these huge monuments of architectural skill their light, but their most highly prized feature, a safe and fast elevator as well.

* * *

Trade With the Philippines.

It is interesting to note, and in the face of criticism to the contrary, that our exports to the Philippines are slowly on the increase, and this at a time when the entire importations into the islands show a decrease. Taking the total importations from all sources for the ten months ending April, the latest period for which complete returns are available, we find that a slight increase was shown from that of $27,006,381 in 1903 to $28,344,971 in 1904, decreasing again in 1905 to $24,966,193, the largest decreases being in the importations from Asiatic countries, where the decrease as compared with the returns of last year has been from $15,172,881 to $10,809,724. On the other hand, the returns show that the importations from the United States during the first ten months of 1903 amounted to $3,380,855, in 1904 to $3,788,111, and in 1905 to $4,514,259.

There has for some time past been a tendency in certain quarters to minimize the growth of our trade in the Philippines during the period which has elapsed since our occupation of the islands. It must be remembered that there are peculiar conditions existing which do not always maintain upon the acquirement of new possessions. Previous to our acquirement of the islands there had been a very limited demand for our goods, and under the change of regime the American exporter has not found any special privileges to induce him to follow the national flag; and it should not seem to be a matter for criticism that after seven years we have not appropriated to ourselves the entire trade of the islands and have diverted it radically from the channels in which it has long been established.

Owing to the Russian-Japanese war the fiscal year figures for 1905 represent a disturbed condition of Eastern trade unsuitable for comparative commercial purposes, but a study of our exports for the previous year are of interest in connection with a showing of what the American exporter is doing in our insular possessions—a showing not without credit except to those anticipating a commercial conquest of the islands in too short a time after we have acquired them.

That the present $5,000,000 worth of exports of American goods to the islands, which has raised the United States from an insignificant rank to a foremost place in the Philippine trade, is in considerable measure due to the presence of the flag with its contingent of Government employes having preference for American goods is no doubt true, but in the large increase there is still enough left to indicate an active and healthy export trade, and there is matter for satisfaction at the record made by the American exporters in a brief period against established competitors in this new field.

Statistics show that we are the leading source of supply in telegraph, telephone and other electrical instruments. For the first ten months of the past fiscal year we supplied $31,990 out of a total importation of $48,434, our nearest competitor being Germany with a value for the same period of time of only $5,180. Under the heading of incandescent lamps, we supplied $3,057 out of a total supply value of $5,718; here again Germany was second, the value being $867. Out of a total importation during that period of $30,597, we contributed $16,572, or more than one-half. Under this heading our nearest competitor was Great Britain, with her value of $5,287. Under the heading of electrical machinery we supplied $106,446, out of a total value of $112,784. This is certainly not a showing to be despised.

◆

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The advocates of municipal ownership for Greater New York would do well to make a careful study of the book recently issued by Mr. M. J. Francisco, entitled "The Business of Municipalities and Private Corporations Compared."

◆

A new illuminant called lusol is being tried by the Paris authorities with a view to its use in the streets. Lusol is a product of the gases of cokes of certain mines, is rich in carbon and is said to possess superior illuminating power.

◆

The Electrical Committee of the Underwriters' National Electric Association will hold its annual meeting at 32 Nassau street (rooms of the New York Board of Fire Underwriters) on December 6.

◆

J. C. R. Laflamme, president of the Royal Society of Canada, has been appointed by the International Waterways Commission as geological expert to make a report upon receding of the Canadian side of Niagara Falls. It is said the Canadian side has receded 300 feet in 80 years.

◆

The Franklin Institute's programme of lectures for the winter season includes Dr. F. A. C. Perrine, of New York, on "Power Transmission," and Charles E. Waddell, electrical engineer of the Biltmore estate, Biltmore, N. C., on "Forest Denudation and Its Effects."

◆

A dispatch from Milwaukee Wis., to the New York "Times" (October 20) says: "The Bullock Electric Company of Cincinnati has been absorbed by the Allis-Chalmers Company of Milwaukee, and the General Electric Company has purchased the majority of the Allis-Chalmers common stock. According to reports, E. C. Converse of Pittsburg, as the result of a deal, has been made a director in all three companies. Only a few weeks ago the capital stock of the Bullock Company was increased to $3,000,000 to enlarge the plants. The Allis-Chalmers Company, a rival of the General Electric, leased the Bullock Company in March, 1904. The price at which the General Electric obtained control, it is reported, was $25 a share for the common stock."

◆

An expert in the manufacture of rubber gloves for electricians states that while testing with water is a good way of finding imperfectly made joints, it is of no use for finding defects in material, such as grit or air bubbles below the surface. These are quickly found by a high voltage test with alternating current in water, without which test the use of the gloves may be more dangerous than their neglect. Every pair of gloves, says the London "Electrical Review," should be certified to have passed an alternating current test at 5,000 or 10,000 volts, according to the requirements. It is useless to test a sample pair, where human life is at stake, and every engineer purchasing such gloves should insist on an adequate guarantee of their reliability as stated above.

◆

It was voted by the corporation of the Massachusetts Institute of Technology in Boston to withdraw every proposal looking to a merger with Harvard University.

◆

The principal reason for the delay of the Grand Trunk Railway Company in equipping the St. Clair tunnel with electricity is that the company's engineers are investigating the feasibility of Niagara power.

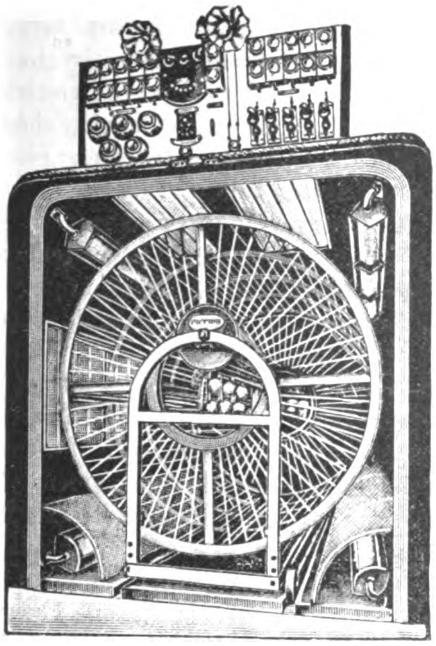
◆

The direct telephone line between Bucharest and Buda-Pesth was nearly completed on September 1, and it was announced would soon be put into regular service. The Roumanian service is fixing the line between Sinaia and Predeal, whilst the Hungarian service is fixing the line between Predeal and Brashov, where the direct line with Buda-Pesth is joined. When this line is finished, Bucharest will be in telephonic communication with two centers of international communication, viz., with Buda-Pesth via Predeal and Brashov, and with Sofia by the direct line between Bucharest and Giurgevo, the Danube cable between Giurgevo and Roustchouk, and the direct Bulgarian telephonic line between Roustchouk and Sofia.

SOME NOVELTIES OF THE LONDON ELECTRICAL EXHIBITION.

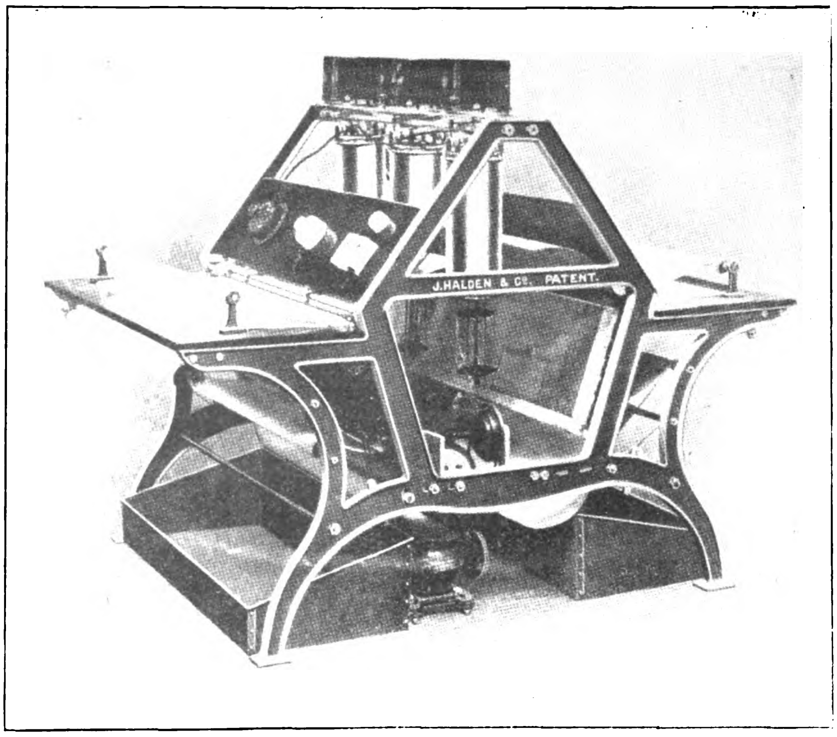
(From our London Correspondent.)

A feature at the London Electrical Exhibition possessing considerable novelty, and one which promises to be of commercial utility, is noticeable in the form of an electric disinfector for use in hotels, nursing and medical institutions. We give an illustration of this. It consists of a large metal chamber 7 feet in height by 9 feet long and 6 feet wide, fitted with the Dowsing system of heating by means of powerful electric lamps. In the center of the chamber, it will be observed that there is a rotating cage with five sections, into which bedding and other articles can be placed for disinfection. The system employs simultaneously both light and heat to kill the germs of disease, and of course the use of steam and chemicals is dispensed with entirely. The temperature employed is from 300 to 350 degs. Fahr. It is believed that this is the first attempt to use light rays for the destruction of disease germs in bedding and clothing on the lines of Finsen's discovery. Another application to which this Dowsing disinfector is being put is in the treating of moth-eaten articles, the effect of the light and heat treatment being to kill the insects and their eggs. It is interesting to mention here that central works are to be erected shortly in London, where the apparatus will be available for the treatment of articles for the public.



Electric Disinfector for Hospitals.

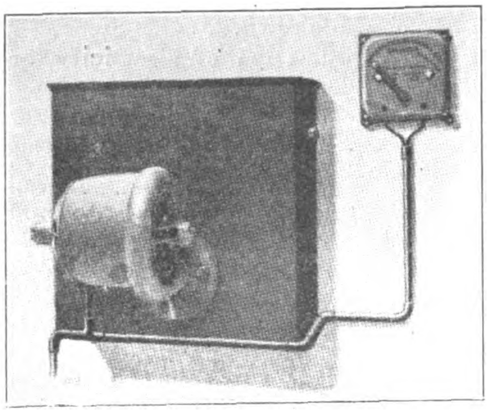
A device which especially appealed to the domestic tastes was the Bonis patent electric sweeper, cleaner and ventilator. This is a portable arrangement, consisting of an aspirator with motor and suction attachment, and a separator or dust filter. A motor of one-sixteenth horse power is used. The brushes, which are attached to a hollow pole like a broom handle, or moved by hand, are bell-shaped in form, having the bristles arranged around the outer rim in such a manner that the air can pass freely through them. The suction produced in the center of the brush by the motor draws into the receptacle the dust, dirt, fluff, etc., removed in the sweeping. India-rubber brushes are used for fragile objects, furniture, etc. The air being loaded with dust is caused to pass through a separator provided with a number of cells for retaining the dust, after which the filtered air is passed through a canvas bag out into the open. The receiving chamber can be made in metal and provided with a disinfecting fluid, thus deodorizing all substances as they enter. The mechanical part of the apparatus, provided with motor and exhauster, can be used as a ventilator.



Electric Photo-Copying Machine.

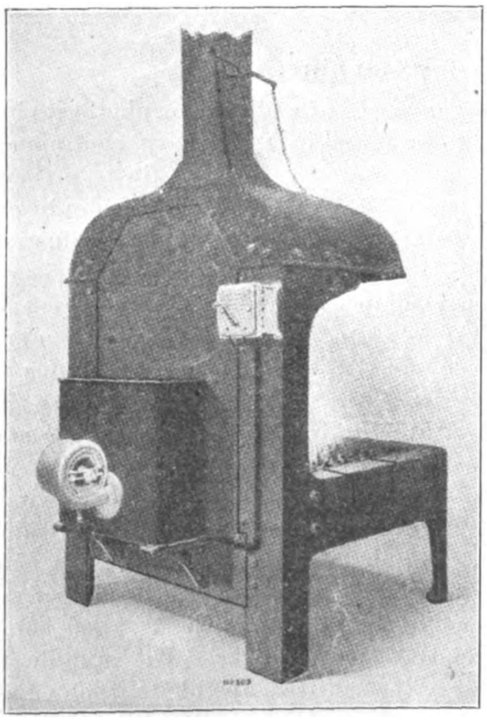
An ozonizer intended for the sterilization of water is shown by the Lahmeyer Company. It is for fixing to the ordinary house lighting mains and water taps. By means of electric current ozone is generated in the ozonizer, and is led to the water tap by means of a thin flexible tube of metallic compound most suitable to resist the chemical action of pure ozone. In this tap there is a diffusing chamber where the ozone is mixed with water, and as the ozone generated is considerably in excess of the amount actually required to sterilize the normal flow of water in any household tap, the sterilization is most effective. One of these ozonizers has been fitted up in the laboratories at Guy's Hospital, London. At Nice, as already known, the municipal authorities are now erecting a large installation for the treatment of the town's supply of water. The output of this installation is to be about 5,280,000 gallons of sterilized water per day for the supply of the whole town.

A useful application of electricity for the purposes of engineering photography is to be found in the Halden continuous photo copying machine. It is a new thing in England, having been only on the market a few months. The illustration will convey a fairly accurate idea of the machine, which is made in single and double form. The latter is the more economical as the one set of arc lamps is arranged in a simple manner to cause the arc light to work on two tracings and prints as they pass gently before it. In working the machine the operator winds on to a loose spindle the tracing, which may be 50 or 100 yards long, or a continuation of tracings lightly joined to each other, the spindle thus filled being replaced in its forks. The spindle to carry the sensitized or photograph paper is run through the roll and in its turn placed in its forks on the table of the machine. The operator draws the end of the tracing on to the end of the photo paper, guiding the two combined to the contact rollers, when he starts the motor which propels the machine. Both substances are fed on to the upper contact roller and the arc lamps are switched on. The tracing with the photo paper behind passes almost imperceptibly between the flat glass plate and the contact rollers. The speed at which Rapid Ferro paper receives the correct exposure is one minute per foot lineal of paper, regardless of width, with 200 voltage. The work is done at table height, the height of the apparatus including the arc lamps being not more than four feet. The motor is of one-eighth horse power and is adjustable to various speeds.



Motor and Blower Combined.

There was also shown for the first time an electric motor and blower combined for blowing smith's fires, furnaces, etc., which is well worthy of mention. The present system of arranging a smith's shop with one large blower for all fires is very inefficient and wasteful of energy, and the small blower and motor have been now made combined in one piece for fitting direct to the tuyeres of each forge. The one casting forms the casing of the blower and the field of the motor. The air propellor is of aluminum, and the weight of the revolving part is very small. The motor is series wound and has carbon brushes. An extension of the blower fits inside the tuyere and carries a valve which prevents the gases from the fire coming back to the blower; this is opened and closed automatically by the air.



Electric Motor and Blower Applied to a Smith's Fire.

◆

LIGHT, HEAT AND POWER PRINCIPLES.—V.

BY NEWTON HARRISON, E. E.

Methods of Distributing Electricity.—The evolution of the incandescent lamp led to further development in methods of distributing electricity for light and power. At the same time the dividing line between the engineering field devoted to direct current and the engineering field devoted to alternating current became more and more eliminated. Electricity is developed at present in two ways:

First—By means of direct current machinery.

Second—By means of alternating current machinery.

The apparatus employed in each case naturally led to a difference in the methods of distributing the electricity. In the first case, the continuous current is generated and led directly, through the medium of large conductors, to the street, and past thousands of homes and business establishments. In the second place, the electricity generated at a dangerously high pressure is led, by means of small conductors, to points where its distribution is required; and then, by means of transformers, lowered in pressure and led into places where it is to be used.

Distinguishing Differences—Taking the point of view of labor and expense, the situation presented is that of one system, using more copper because of a low pressure direct current being employed for incandescent lamps, arc lamps and motors; and the other system, employing a high tension alternating current, which is not distributed directly, but indirectly, by means of transformers to the points where it is to be consumed. These disguishing differences are at present of importance, because the outline of each system in this respect shows the extent of its adaptability to large or small cities. An outline of each system will also serve to show where they may be advantageously combined, as already suggested, and as they are combined in large central stations.

Outline of the Alternating and Direct Current Systems.—The alternating current system in outline makes use of the following elements to compose the system as a whole:

ALTERNATING CURRENT SYSTEM.

1—The alternator. 2—The exciter. 3—The switchboard. 4—The transformer. 5—The system of distribution. 6—The motors, arc lamp and incandescent lamp.

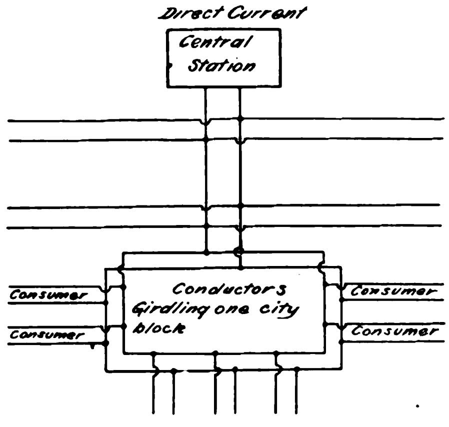
The reference made to the lamps and motors is in order to present the idea that the system can operate motors if their construction is adapted to the character of the alternating current employed. In this respect the additional items must be added, entitled: First, single phase; second, two-phase, and third, three-phase currents. Each of these currents will operate arc and incandescent lamps, and each can operate motors, provided they are constructed so as to fall within the classification of single, two or three-phase motors.

The direct current system is simpler, in the respect at least that the electricity is not transformed after leaving the central station as regards its pressure. Its elements are as follows:

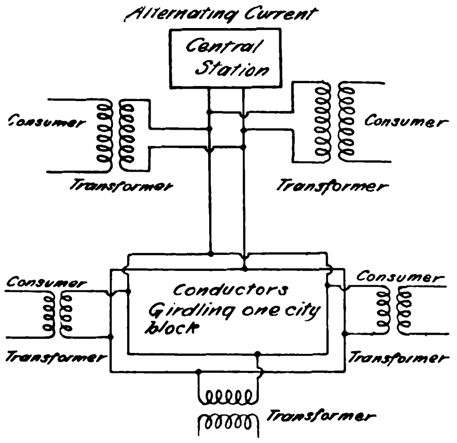
DIRECT CURRENT SYSTEM.

1—The generator. 2—The switchboard. 3—The system of distribution. 4—The motors, arc lamps and incandescent lamps.

It is evident that the absence of any sub-generator to the dynamo in use, and the absence of transformers, is illustrative of the directness of this system. The conductors practically lead directly from the generator to the consumer via the station and street or overhead wires. In the alternating current system, however, the metallic connection between the station and the consumer ends in the primary or—in this case—the high tension coil of the transformer. At this point the inductive relation begins. The consumer's light and power in this system is derived from a coil simply placed in juxtaposition to the other coil whose extremities connect with the station. There is no metallic connection, no direct electrical connection, but merely an inductive relation supplied between the station and the consumer. In showing these two systems of supplying electricity for light and power from a central station, or a station deriving its power from a larger and more distant station; the characteristics of the alternating will appear, emphasizing the discontinuity metallically, but likewise indicating the continuity with the direct current. The reason for this difference is found in the peculiarities of the two currents. The energy of one can be transmitted readily through a large enough conductor and used as it is transmitted. The energy of the other is transmitted through a smaller sized wire, and is either used at the beginning or end of the circuit, or both, to create inductive action. This causes a condition to exist, of a system composed of a series of separate parts, at the points of metallic separation, associated, however, only inductively. This condition is imposed by the fact that the transformation of the pressure of an alternating current up or down can only be caused practically by inductive action.

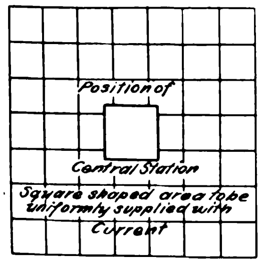

Direct Current
Central Station
Consumer
Consumer
Consumer
Consumer
Conductors Girdling one city block

Complete Metallic Connection to Consumers from the Central Station.

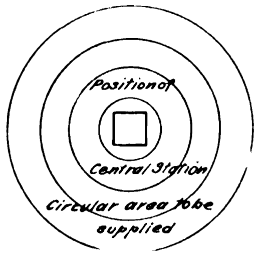

Alternating Current
Central Station
Consumer
Consumer
Transformer
Transformer
Consumer
Consumer
Conductors Girdling one city block
Transformer
Transformer
Transformer

Metallic Connection to Consumer, Not Complete.

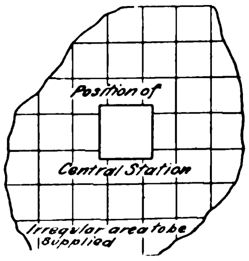
Position of Central Station.—The central station must be regarded as a reservoir of electricity distributing the energy to the different customers in the neighborhood. The position of this reservoir therefore, with regard to these self-same customers must be such that a minimum of power is wasted, and the least possible amount of copper utilized. In other words, the lines are not laid carelessly or purposely, but are placed in certain locations with regard to the central source of energy so as to attain these objects.


Position of
Central Station
Square shaped area to be uniformly supplied with Current

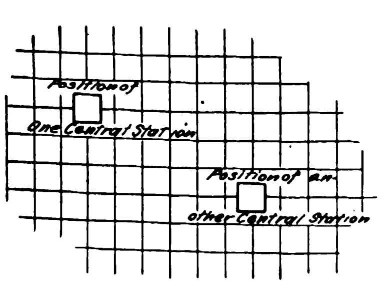
Customers Occupying Places Forming a Square-shaped Area.


Position of
Central Station
Circular area to be supplied

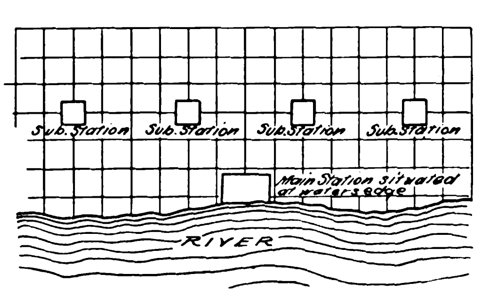
Customers Occupying Places Forming a Circular Area.


Position of
Central Station
Irregular area to be supplied

Customers Occupying Places Forming an Irregularly-shaped Area.


Position of One Central Station
Position of another Central Station

Two Separate Central Stations Employed for Electric Light and Power.


Sub-Station
Sub-Station
Sub-Station
Sub-Station
Main Station situated at water's edge
RIVER

One Central Station with Auxiliary Substation Employed for Electric Light and Power.

If, for instance, a series of city blocks are taken into account forming a square shaped area, it is quite evident that the best position for the central station is that formed by the intersection of two diagonals from the corners of the square. On the other hand, if the city area is circular, the center of it would be approximately the best position for the station. The presumption is, in each of these, or in other cases that the demand for lighting is nearly uniform. By this is meant, that either the list of customers is one which gives a uniform distribution, or other indications lead to the conclusion that the lighting will eventually become uniformly distributed. In this case, whether the current used be alternating or direct, the best possible position for the central station is one in which it is about the same average distance from certain distinct groups of consumers. If the customers were grouped in a circular area, the center of this area for the central station, would place the customers in a series of concentric bands. Or, if the area of current distribution is square, the position of the central station is likewise determined as that approaching the center of the listed customers.

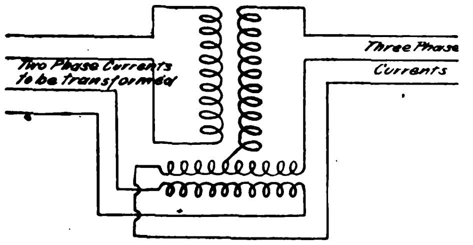
The Central Station in Practice.—A large city may not present a case where it is economical to feed all conductors from one center. For this reason a series of centers are inaugurated, from which conductors lead to a given area of city blocks. A number of central stations would then be employed to supply the entire city with electricity; but it will be divided up in this case into sections or divisions, and each division will be treated as an independent case.

Another method is that of having a single great station situated in a given position, either at the center, or preferably at the edge of the city line. From this point, conductors are run to substations situated where central stations proper would otherwise be necessary. The sub-stations thus constitute centers of distribution for a given area. They could be entitled distributing stations as regards their actual function. The idea in any case is to reduce the annual power loss in the distribution, and to minimize the primary outlay for copper. Another governing reason is the cost of real estate. A position near the water, such that coal barges can anchor directly under the station and deliver their coal, is preferable to any. By this means the fuel cost, as far as the delivery is concerned, is held in check, and the water required for condensers, etc., readily obtained.

An examination of the conditions of lighting of any great metropolis discloses the fact that the elements employed are practically the same as would be installed for actual power transmission. The original energy may be developed at a pressure far too high for use, without the aid of converters. The advantage being that the development of a high pressure alternating current means a limitation not only of the copper, but of the power which would otherwise be wasted as well.

General Use of Polyphase Currents.—The simple alternating current is not sufficient for the purposes required of it. A motor built to operate on a single phase circuit must either be started up by outside power, or its starting device is not one that shows other than an effort to meet this condition with certain complications.

A single phase motor does not possess the widely recognized advantages of the two or three-phase motors. For this reason, it was to have been expected, that the polyphase current systems would ultimately represent the highest standards of power generation, transmission and distribution. That they would predominate in all cases where large enterprises of this kind were projected is also a logical conclusion borne out by practical experience. At present the central stations in large cities are of a composite type, particularly New York. Both the polyphase system, and that termed the direct current, are used in conjunction with other. It is evident that as far as the economical handling of the electrical energy is concerned the polyphase occupies the most prominent position. The distribution is made in the shape of direct current. Not only does electric lighting gain great advantages by its use, in the way of copper, real estate for stations, and therefore the avoidance of an unusually heavy investment, but the system of power transmission is entirely dependent upon this form of electrical energy. The ease of transformation of three-phase into two-phase, or *vice versa*, and the readiness and economy with which either of these is turned into direct current, has been the means of simplifying and making practical the handling of large quantities of power at distant points. A diagrammatic sketch of the transformation of two into three-phase, is added for reference.



The Transformation of Two into Three-phase Currents.

THE NAVAL ELECTRICIAN.*

The idea of becoming a naval electrician probably appeals to a good many lads who have some knowledge of electricity, and fancy the prospect of going out into the world on board a man-of-war; to not a few of these the uniform is, perhaps, an attraction, with its peaked cap and brass-buttons savoring of the full-blown naval officer.

Far be it from us in any way to discourage a feeling of pride in the uniform of either of the services, for it is surely a pardonable form of vanity that brings out such qualities as are needful "for the sake of the cloth."

However, it is but fair to point out to those who may only have seen the shore-going side of life, that there is a good deal beyond the peaked cap and the high-sounding title of electrician, which does not appear on the surface.

To begin with the title electrician is, perhaps, a little misleading, for it would seem to imply that the holder of it is responsible for, and generally in charge of, the electrical plant on board ship. One might be led to infer that his opinion on electrical matters would have considerable weight, and that he was, in fact, more or less of a "boss" in his own particular line.

Now, as a matter of fact, the electrician is not an officer at all in the naval acceptance of the word; he is a mechanic pure and simple, supposed to have special knowledge of the sort of work required in the adjustment and repair of electrical instruments.

The electrical engineer of the ship is the torpedo officer, whether he be a warrant officer or a lieutenant appointed for those duties; his right hand man is the torpedo instructor, a man who has entered in the ordinary line and has taken up the torpedo branch in preference to gunnery.

The electrician occupies rather the post of instrument maker, though his actual duties in a great measure depend on his special aptitude for certain kinds of work as observed by the torpedo officer.

As an example, let us take a battleship or large cruiser, and see in what manner the work is generally divided up, and what duties in particular will be likely to come under the care of the electrician. To do this we must endeavor to place ourselves in the position of the torpedo officer, and see what arrangements are best suited for the disposal of the staff under him.

As regards the work that it is his special duty to supervise, it may be divided first of all into two great items—the illumination of the ship and the efficiency of the Whitehead torpedo armament.

His staff will probably consist of two electricians, two torpedo instructors, a few permanent ratings in the torpedo branch—some half dozen or so, and any men that the commander may be able to spare for special work that is in hand and requires what one might call unskilled labor, such as the cleaning of torpedo tubes and such minor odd jobs.

The half dozen or so permanent "hands" would be called the electric light party, and the bulk of them would be employed going round chasing earth leaks, repairing circuits and renewing lamps wherever necessary.

A responsible man must be in the neighborhood of the switchboard, another reliable man should be in charge of the electric light party, a third is required to look after the bells, batteries and telephones.

Now all these men have their own little calls upon the electrician's workshop; they go round and gather up the fragments of misapplied ingenuity which follow in the wake of untutored ambition.

There are switches which have suffered from some burly autocrat who did not realize that the current was broken at the sectional box, galvanometers which have had their faces slapped and turned sulky, other instruments which have displayed a marked antipathy to sea water, and a host of minor fittings with which sea air does not agree. All these things claim the attention of the electrician, and test his skill as an artificer in brass, but they do not, as a rule, require any great technical knowledge. The electrician whose duty it may be to attend to these items has his hands full, and it is always easier to write up the defect book than to write the items off.

But, besides electric work, the torpedoes claim a large amount of the torpedo officer's attention; men must be detailed to look after these, and a specially skilled and neat workman must attend to the gyroscopes, upon which the straight-running of each torpedo depends.

A gyroscope consists essentially of a perfectly-balanced heavy fly-wheel, running on ball bearings.

Now, everyone who has possessed a bicycle knows that it requires a definite amount of force to turn the front wheel when it is set spinning rapidly in the air; it is precisely this force that is made use of in the gyroscope when the little fly-wheel is set revolving, and the resistance to any turning movement is made to act upon valves which control the rudders.

This little instrument, which forms an integral part of each torpedo, is exceedingly sensitive, and at the same time it is of the utmost importance that it should be accurate.

Who better than the electrician with his skill in handling delicate instruments, for the job? So it comes about that electrician No. 2 becomes a specialist in the art of gyroscope adjusting to the exclusion of almost any kind of electrical work whatever.

Now, to the man who has taken up electricity as a study, who has studied the theory of it, and, perhaps, prides himself on his electrical certificates, this may, possibly, be decidedly disappointing; he had, perhaps, visions of wireless telegraphy, and the large field of investigation that this branch of the subject throws open to the inquiring mind; he had pictured himself in charge of a ship's installation with all its ramifications, the ball systems, telephones, telegraphy, lighting, battery work, dynamo and motor work and all varieties of testing; his certificates are a guarantee of his right to an opinion, and his title would seem to invite it, but he finds himself instead tied down to his lathe, making endless terminals and ebonite bases, carrying out routine orders, and consulted in nothing; there is another in the place that he thought to occupy, and he is not even this person's deputy, for there are torpedo instructors whose official certificates entitle them to a higher place.

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*From the "Electrical Review," London.

It may not always be so—in fact, it is probable that there will be great changes in the new future—but for the present we would point out the advantages of working up through the regular line where it is a case of ambition, for the torpedo instructor becomes eventually a torpedo officer, and, in due course, may even get a commission.

The naval electrician is, however, not at all badly placed when once he realizes his true position; as an instrument maker no one can touch him; he is master of his craft, and as such will earn the confidence of his officer. Once this is established it is not likely to be forgotten, and he will be looked upon as a man of no small importance.

Electricity is more or less of an innovation in the navy, and it is daily growing in importance. The electricians, as a body, must remember that the engineers started in much the same way, only with more prejudice against them; within the last few years recognition of their merits has come to them in rapid strides, and there would seem some liklihood of considerable changes being effected in the electrical branch.

Torpedoes and the electrical plant have little in common; the link was first welded in the adoption of electrically-fired mines, when the torpedo officer was the only individual who was supposed to be sufficiently well acquainted with the fact that electricity can only travel along a metallic circuit, and is held there by the surrounding insulation through which it cannot pass.

In these days of high frequency currents, specific inductive capacity, self-induction, and so forth, he has to know a good deal more, and modify the views of his predecessor considerably; leaving out his executive work, leaving out even his Whitehead torpedoes, he has still quite enough to worry him as an electrical engineer, and the day is probably not far off when, putting aside his other duties, he will assume the latter sobriquet alone.

AN ELECTRIC MINE PUMPING PLANT IN BELGIUM.

BY FRANK C. PERKINS.

One of the most interesting electrical mine drainage installations in Belgium is that at the Concorde Collieries at Jemeype-sur-Meuse. The accompanying illustration, Fig. 1, is an interior view of this mining power plant, and Fig. 2 shows the underground electric pumping plant.

In the mines at Maquets the company has a beam engine which has been in operation since 1878, two electric pumps, working at a depth of 1,330 feet, and an underground steam pump, working at a depth of 680 feet. The electric pumps were originally operated by continuous current motors, but are now driven by alternating current motors of the three-phase type. About a decade ago an electrical pumping plant was installed, consisting of an inclosed motor driving by two sets of gearing a three-throw pump capable of delivering 3,250 gallons per hour to a height of 1,330 feet, the speed of the pump being 31 r.p.m. The current was generated at a pressure of 500 volts by a direct current dynamo of the International type, driven at a speed of 375 r.p.m. by a vertical compound condensing engine of 200 hp. capacity, built by Willans & Robinson. A second electrical pump was installed in the underground plant a year or so later with an electric motor of much larger dimensions than the former, which had not given the best of satisfaction. The motor was also of the inclosed direct current type, but had a lower temperature rise on account of its larger dimensions, and also as it was fitted with water circulation to further aid in cooling. This equipment operated for a number of years successfully, although the first pump which had become generally defective was replaced by a new electric three-throw pump in 1900, and the output of the generating plant was increased by installing a Carels steam engine, directly coupled to a direct current dynamo of 500 volts pressure.

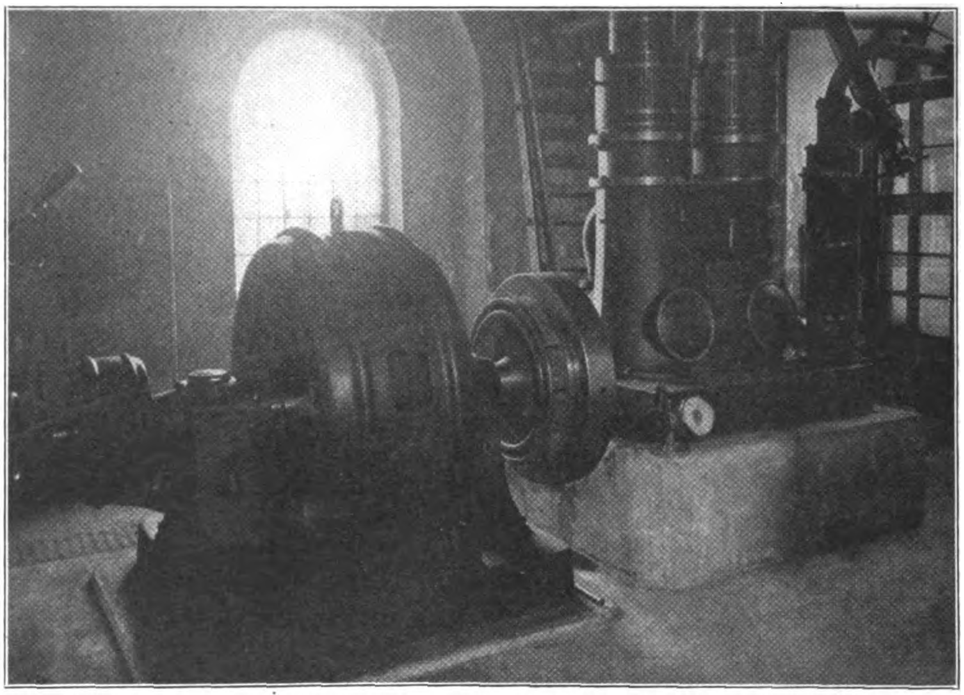

Fig. 1.—200 Hp. Engine and Alternator in Power House of Electrical Mine Pumping Plant.

An entirely new electric installation for mine pumping was under consideration when the beam engine became damaged by an accident and the lower underground pumping room was flooded at a depth of 1,330 feet, the direct current motors being ruined by being submerged in the pump room for about two weeks.

The entire installation was then converted into a three-phase alternating current mine pumping plant by the International Electrical Engineering Company of Liege, Belgium, and a test was made by two professors from the Liege University, showing that an alternating current motor of the three-phase type could be operated under water without damage for a short time. An International three-phase motor was completely immersed in water and operated for a quarter of an hour in this manner when it was placed under seals after being stopped, and remained submerged for a night and a day. It was run for a short time by Professors Gerard and Debast and then removed from the water and allowed to dry for 24 hours, when the motor was found to be in perfect running order and the insulation in good condition. The new plant installed in the Concorde Collieries included a three-phase alternator directly coupled to the Willans & Robinson 200 hp. engine, which has a high pressure cylinder with a diameter of 300 mm. and a low pressure cylinder of 433 mm., the piston stroke measuring 203 mm. The Carels engine was also coupled to a similar alternator having 14 poles and supplying a current having a frequency of 43.8 cycles per second. The Carels engine has a piston stroke of 200 mm., the high pressure cylinder measuring 300 mm. in diameter and the piston measuring 430 mm. in diameter. A steam pressure of 10 atmospheres is used, the condensation being by injection, the water pump from the mine being used for this purpose in a reservoir 30 feet above the condensers.

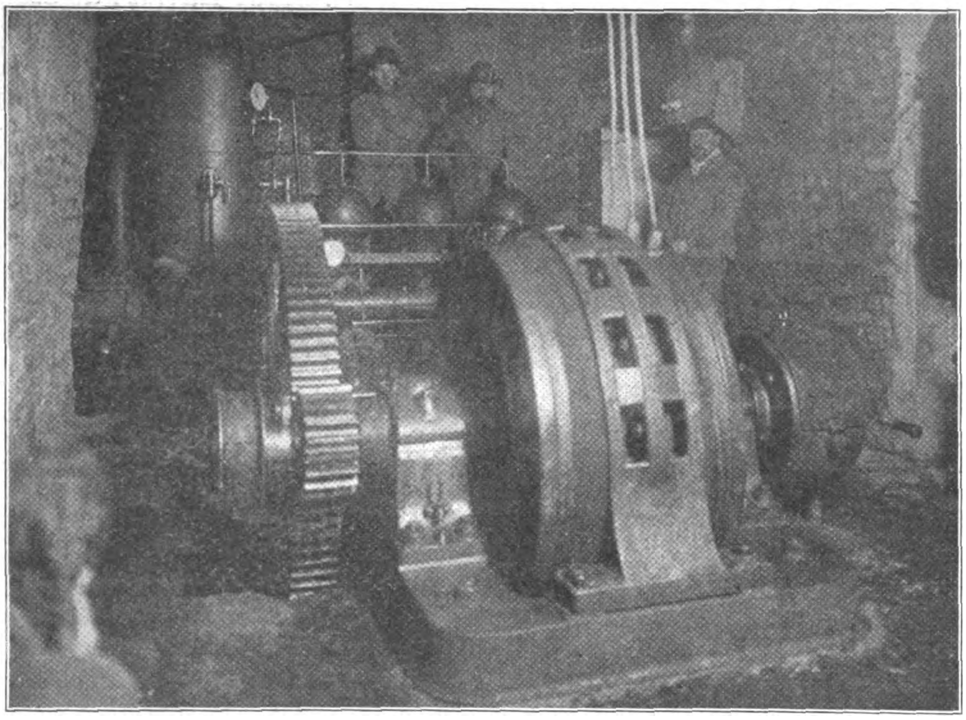

Fig. 2.—Belgian Underground Mine Pumping Plant.

The exciters and their alternators are connected to the switchboard by cables running in conduits. This switchboard consists of three white marble panels, the two end ones being reserved for the generators and the center one for the exciters and the synchronizing circuit. The current passes through the circuit breakers and then through the switches before reaching the feeder cables. The board was designed to make the service simple and sure and to prevent any false operating which might arise through an accident. All the metallic parts carrying current at high tension are placed at the back of the board, which latter is constructed without the use of any combustible material. The frame is of iron and the insulators of porcelain.

The safety fuses are composed of long pieces of silver wire stretched down the center of the porcelain tubes and fixed to removable contacts. By means of these contacts the fuses can be replaced without danger while the generator is running. The switches are operated by means of long metal rods carrying the contact blades by means of insulated pieces. They are of the quick-break type, and the rapidity with which they open together with the distance between the contacts enables the current to be cut off when the machine is running with full load without fear of permanent arcs being produced. The three feeder bars are connected to a three-core armored cable 480 meters in length, which carries the current to the bottom of the pits and thence to the motors. The three conductors, which have each a sectional area of 75 sq. mm., are first covered with vulcanized rubber, afterwards stranded, the whole then covered with two sheetings of lead and finally armored over all with tinned steel wire.

At the depth of 1,330 feet the cable leaves the shaft and is conducted along a gallery to the pump room, where a junction box is placed in a convenient position, and from which run the two cables feeding the pump motors. In each of these circuits a high tension single-phase circuit breaker is fixed of the same type as those at the surface but inclosed in a cast-iron box. This box also contains a switch, which can be controlled from the exterior, and an ammeter, which can be examined through a glass window arranged for that purpose. Each pump is driven by a motor with revolving field of 80 effective horse power at a speed of 420 r.p.m. One electric pump has a speed of 31 r.p.m., and is driven by means of two sets of gearing; the other one has only one set of gearing and a speed of 80 revolutions.

The starting is effected by means of a rheostat with metallic resistances working in oil having inclosed contacts, which are connected with the rotor by means of slip rings in a hermetically inclosed box. They are fitted with an arrangement for putting in short circuit and lifting the brushes.

The motors are especially designed for resisting the hot atmosphere and dampness of the mine and the conductors are protected by waterproof insulation.

SINGLE-PHASE VS. POLYPHASE TRANSMISSION LINES.[*]

BY H. S. WATSON.

In spite of the great success of three-phase alternating systems signs are not wanting that electrical engineering opinion may yet return to the almost discarded single-phase system; in fact, the merits of the latter for large traction schemes are so incontestable as far as the most important part of the problem is concerned—viz., the track work—that when the single-phase motor problem has been fully solved there will, in the opinion of the writer, be no question of using any other system on electric railway schemes of any magnitude.

The advocates of single-phase have not been afraid of conceding to the three-phase system a saving of 25 per cent. in the copper of the transmission lines; and it is this supposed disadvantage of the single-phase system to which I wish to draw attention; not that my view is a new one, as it has often been stated before, but fallacies die hard, and I believe that even to-day many electrical engineers have an implicit faith in the high copper efficiency of three-phase transmission.

This relative copper efficiency, paradoxical though it may seem, depends entirely on the point of view from which the question is looked at. Everyone knows that in any given system for the same efficiency the weight of copper varies as the square of the voltage. In comparing the copper efficiency of a three-phase system with a single-phase system it, therefore, becomes absolutely necessary to decide on the basis of comparison. If we assume that a single-phase system with 10,000 volts between its lines is comparable with a three-phase system having the same voltage between its lines, of course the three-phase system has the lower copper cost for the same efficiency. But is this a fair basis of comparison when an overhead line is in question?

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[*] From the "Electrician," London.

Consider what is really the condition that governs the two cases. It is that the insulation between any one line and earth shall be the same. This is obviously so since the distance between any two lines should be so great that there is no chance of leakage or breakdown from one line to the other, and therefore the only thing to take into account is the leakage from any conductor to earth. That is to say, the insulators are the determining factor. Let us first, as our basis of comparison, take a three-phase system connected up in star with the center point earthed, having a given voltage, V, between any conductor and earth. The voltage between the phases is $\sqrt{3} \times V$. Let the current flowing in each line be 2C. Then the power which will be transmitted is $(\sqrt{3}V \times 2C)\sqrt{3} = 6VC$, and the amount of copper required in the system for any given efficiency will be proportional to $2C \times 3$ (since there are three lines) $= 6C$.

Now, take the case of a single-phase transmission line. To obtain the same condition—i.e., the same voltage V between any line and earth—we must earth the system at the middle point; then the voltage between the two lines will be 2V. Now the contention is that, if the copper be the same in the two systems, the power transmitted at the same loss will be the same; as the quantity of copper is to be the same as before, it is proportional to 6C; therefore, having only two conductors, the current flowing in each, for the same loss, will be $6C \div 2 = 3C$. The power transmitted will therefore be $2V \times 3C = 6V\ C$, the same as in the case of the three-phase system. In other words an equal power can be transmitted with the same efficiency in the two cases, if the weight of copper is the same. Whether the three-phase system is supplied by star or delta-connected generators of course does not affect the argument; if the star system is used, it is easy enough to connect the center of the system to earth; if the delta system is used, the same effect can be obtained by making an earth connection through choking coils.

It is interesting to note that in America it is found that for extra high tension (40,000 to 50,000 volts) the greatest difficulties to be dealt with are the insulators and the lightning arresters; the potentials to earth, and not those between line and line, are the causes of these troubles.

When such high voltages are employed, whether a three-phase or a single-phase system is used, it will probably be found best to adopt the system of lightning protection recommended by J. Moscicki and W. Waeber, in which each line is connected to earth through a condenser with a choking coil in parallel with it. This method, whether applied to a three-phase or a single-phase system would, of course, insure that the potential of each line was equidistant from earth.

The above arguments lead to the consideration of the question whether, with overhead transmission, it is better to erect a single-phase or a three-phase installation; and it would appear to the writer that there is some point at which the first cost in the two cases is equal. This point will depend on the distance of transmission, and must be determined by the following considerations: On the one hand, the prime cost of single-phase generators is higher than that of three-phase generators. On the other there must be considered the cheaper switchboard, fewer insulators and 33 per cent. less labor required in erection of the overhead bare cable. As regards the running costs, it will hardly be disputed that the handling of the power station will be facilitated by a single-phase equipment; and with regard to outside maintenance, there would be only two lines to look after instead of three.

The evolution of a practical single-phase motor for factory work has been slow, but is now not very far from accomplishment, and several railways are seriously considering the applicability of single-phase working to their lines. It would seem, therefore, that the relative cost of transmission by single-phase, as compared with three-phase, when an overhead line is permissible, should be considered with more attention than it generally receives, and that the misconceptions as to the copper efficiency of the three-phase system, which are undoubtedly widespread, should be rebutted. It is, perhaps, unnecessary to add that the preceding arguments apply, with suitable modifications, to the comparison of single-phase with two-phase or any other polyphase system.

German Electric Road Statistics.

The statistics concerning German electric road lines show that during the 12 months ending October 1, 1904, the towns provided with such services increased by four. The length of route increased by about 60 miles, representing a total of 2,375 miles. The total output of the generating plant, according to the "Electrical Engineer," London, has increased only by about 1½ per cent., while the total output of accumulators on traction load shows a somewhat greater increase, the total accumulator capacity installed amounting to 39,809 kw. In explanation of the small increase in generator output it may be mentioned that the plant of the Hanover street railways has been reduced from 10,063 kw. to 4,555 kw.

WRINKLES.[*]

EDITED BY H. C. ABELL.

The Washing of Waste and Wiping Cloths.

About a year and a half ago we bought an oil press to press the oil out of waste, and after some experimenting we bought a small-sized washing machine, such as is used in a steam laundry, connecting it up with steam and water and running the same by the use of a 3 hp. motor we had on hand. We now wash all of the waste and wiping cloths used by running the machine for about two hours once a week. We use a washing soap called "Takeanap," and some washing soda with it, and make quite a saving over buying new waste. C. E. INMAN, Warren, O.

Installing Apparatus on Second Floor as Protection from Floods.

In planning an alternating current substation in a location subject to possible flooding from a nearby stream due to freshets it was found that a saving of 10 per cent. in the cost of the building could be made by installing all apparatus on the second floor, approximately 12 feet above the street level, thereby saving the waterproofing that would be necessary if apparatus were placed on the lower floor.

LEONARD L. ELDEN.

Single-Phase Commercial and Series and Incandescent Street Lighting from One System.

It became necessary to supply single-phase commercial and series incandescent street lighting service to a small suburban town a number of miles from the substation. The returns possible were so small that it was not profitable to install two wires for each circuit, and therefore three were installed, two of which were for the commercial single-phase service and the third for the street lighting circuit, one of the wires of the commercial circuit being used for the return wire of the street lighting circuit. The only disadvantage to this scheme was the fact that the street lighting circuit was alive during the day, but this proved to do no harm, and, as it was necessary to work the street lines, a switch was installed on a pole in the district supplied, which opened the street lighting wire attached to the commercial circuit, thereby killing the street lighting system and making it safe to work on. Leonard L. Elden.

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[*] Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

Remedy for Blowing of Fuses on Overloaded Transformers.

Two years ago eight 30 kw. transformers were tied into a common secondary supplying the business portion of the town. One night during the peak of the load one transformer blew a fuse, thus throwing the load onto the adjacent transformers; these, in turn, blew their fuses on account of the additional load, and in less than a minute all eight transformers were out of service, leaving the business section of the city in darkness.

The next day circuit-breakers were put in on the secondaries between transformers, and no trouble has since been experienced. To save the drop in copper the various sections were tied together on 75-ampere fuses.

Leonard L. Elden.

Broken Water Pipe—How to Fix Temporarily.

I have found from experience that General Electric splicing gum, with a good covering of Acme friction tape, will hold a broken water pipe until it can be permanently mended.

F. M. Laxton, Atlanta, Ga.

Method of Preventing Destruction of Lead Coverings of Cables at Draw-Bridge Crossings.

A method used to prevent destruction of lead coverings of cables where they enter and leave the water at drawbridge crossings in locations where large quantities of direct current railroad return currents are flowing in approximately the same directions as the cables are laid has been to install a large bare conductor, say 1,000,000 circular mils, in the water across the drawbridge or channel and bond it thoroughly to all the cables on each side of the channel at a point well above the water line of the highest tide. This has entirely obviated the relatively rapid destruction of the lead coverings of lighting and transmission cables from currents of the street railroad company.

Leonard L. Elden.

Thawing Water Pipes.

In thawing frozen water pipes about the plant we have found that a one-inch galvanized-iron pipe is readily thawed by a current of 250 amperes, but a section of 1.5 inch pipe gave us trouble, as it required more current than we could safely supply with the means at hand.

To furnish a conductor of high resistance four No. 10 iron wires were wrapped in a one-sixteenth inch asbestos sheet doubled, bound to the pipe and the latter packed as before. In this case it was convenient to attach one end of the wires to the pipe and use it as a return. We can now thaw the pipe with about 100 amperes. The asbestos is sufficiently good insulation as regards electricity and a sufficiently good conductor as regards heat.

In using this method care must be taken that each wire carries its share of current and that the wires are not overheated; in any case it is wise to watch any combustible material about the pipe.

G. Hartman, St. Gabriel, P. Q.

A NEW GIANT OF THE SEA.

The newest and most complete product of marine architecture, namely, the "Amerika," of the Hamburg-American line, arrived in this port from Hamburg last week.

This new twin-screw ocean liner is a marvel even among the modern giants of the sea. With the exception of her sister ship, the "Kaiserin Auguste Victoria," to be ready for service in May, 1906, the "Amerika" is the largest ship ever built for passenger service. Her construction and equipmemt include many novel features, with regard both to the safety and the luxurious comfort of her passengers. Not only has care been taken to meet every reasonable requirement of the patrons of the new liner, but also to anticipate the whim of the most fastidious traveler; and the effort has produced a craft on which the most timid or squeamish seafarer may brave the terrors of ocean travel with impunity.

This ship has a length of nearly 700 feet over all, a breadth of 74 feet 6 inches and a depth of 53 feet. Her displacement, exceeding that of any other ship in the world, is about 42,000 tons and her gross tonnage about 23,000 tons. Loaded she carries 16,000 tons of cargo, which means that if her full cargo were transferred to freight cars, and these placed end to end, they would cover a distance of 10 miles. She has accommodations for 3,400 passengers and carries a crew of 600, making a total of 4,000, or nearly as many persons as the population of an 18-story skyscraper in New York.

A great novelty introduced in the construction of the "Amerika" is the electric passenger elevator. This is located on the starboard side near the main companionway and serves the five decks of the ship. It is not so many years ago when even buildings in our larger cities were without elevators. But, just as modern progress in mechanical construction has made possible the 30-story building, with its electric elevator, so has similar progress in marine construction brought about like results in this, the latest product of the shipbuilders' art.

Without attempting to enumerate all the novel features of the new ship, a few more may be mentioned. These include a Marconi wireless telegraph apparatus; stateroom telephone service; hydropathic and electric baths and massage, and a thoroughly equipped gymnasium.

It would be of little avail to have made all these provisions for comfort and convenience of passengers, if the more important feature of safety had been given less care. The safety devices on the "Amerika" include the newest and best provided by modern service. Among these is a system for communicating through the water between the ship and the shore. By the use of this system—that of the Sub-Marine Signal Company of Boston—the navigator can find by bell signals the location of lightships and lighthouses regardless of weather conditions. The Stone-Lloyd system for closing the water-tight bulkheads is also in use. By pushing a button on the bridge it is possible in a few seconds to close the water-tight doors of every compartment into which the hull of the ship is divided. Protection against fire, too, is provided by the newest extinguishing system—that of forcing sulphuric acid gas into the threatened premises and smothering the flames.

The "Amerika," while not designed to be a record breaker in speed, is driven by Harland-Wolff quadruple expansion engines of over 15,000 hp., built on the balanced principle. She will make the trip to England and France in about seven days, and that to Hamburg in about eight and a half days.

Overhead Transmission in France.

The new rules as to overhead transmission in France recently appeared in "l'Electrician," Paris. In France continuous current up to 600 volts is counted as "low pressure," so as to include with a comfortable margin all electrically-operated railways. The rules state that single bell insulators or simple oil insulators are not sufficient in the case of high pressure lines and without specifying what contrivance to that end is to be adopted, it is enacted that the wires must be protected from falling across roads. The distance at which wires must be kept from houses or other buildings is one meter. As regards the extra high pressure transmissions which are becoming comparatively common, no attempt is made at present to standardize. It is simply laid down that anything above 10,000 volts will be dealt with specially. On the whole the rules are short and simple enough, but it does not follow that they are all the contractor will have to comply with. In general the local authority has power to impose such additional restrictions as may be suited to the circumstances of the case.

American Institute of Electrical Engineers.

The next regular meeting of the Institute will be held at the Assembly Room of the New York Edison Company, 44 West 27th street, on Friday, October 27, at 8:15 P.M. The subject of the meeting will be "Lightning and Lightning Protective Apparatus." The following papers will be read and discussed:

"Performance of Lightning-Arresters on Transmission Lines," by N. J. Neall.

"Some Experiences With Lightning Protective Apparatus," by Julian C. Smith.

"Note on Lightning-Arresters on Italian High Tension Transmission Lines," by Philip Torchio.

Another Municipal Ownership Tip.

The council at Topeka, Kan., proposes to sell its municipal electric lighting plant. Councilman Frank B. Sims, of that city, had the following to say on the subject: "It seems to me that the plant is a mighty big expense to the city considering the benefit we get out of it. We will have to enlarge the plant to give adequate service to the city and that will cost probably $15,000. Then we will have to pay about $5,000 more for new lamps. If we can dispose of this plant to some corporation that will do the city lighting at a reasonable figure it seems to me that it would be a good business proposition."

Proposals Invited.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until November 7 for furnishing Eastern Navy Yards with the following electrical material: Schedule 190, conduit, Gonda prisms; schedule 191, motor, electric wire, cable, Grimshaw tape, fuses, etc. Blank proposals and detailed information can be obtained upon application to the Bureau at Washington or to the Navy Pay Office in New York.

Good Book Against Municipal Ownership.

We have received from Mr. W. C. L. Eglin, secretary of the National Electric Light Association, Mr. M. J. Francisco's new book, entitled "The Business of Municipalities and Private Corporations Compared," and find it a very convincing argument against municipal ownership of electric lighting plants. Mr. Francisco's former book, "Municipalities vs. Private Corporations," of which the new book is practically a revision and enlargement, was found by many of the members of the National Electric Light Association to be of very great benefit when combating the municipal ownership idea in their respective cities and towns. Mr. Francisco's statements are always carefully verified, and ought to carry the strongest conviction that up to the present time city ownership of electric lighting plants has proved in almost every instance a gigantic failure, and is likely to do so wherever undertaken.

Ticonderoga.

The little hamlet of Ticonderoga, New York State, has two occasions for distinction, one being of war and the other of peace. A fort was built there in the 18th century and was later captured by General Ethan Allen, in behalf of the American army. The occasion of the capture was a thrilling episode in the war of the Revolution long, long ago. The remains of the fort are still in sight and this year, 1905, between 18,000 and 20,000 tourists stopped there and paid the old fort grounds a visit. The United States Government should buy the site and keep the walls from further disintegration.

The other occasion of distinction is the Dixon Ticonderoga flake graphite mines. These have become even more celebrated than the old fort. Outside of these two things Ticonderoga would be in dense obscurity.

An American mining engineer recently made a report, saying among other things: "The Dixon mining plant at Ticonderoga is equipped with the most modern and improved machinery and apparatus for mining, concentrating and refining graphite." Another writer says: "The only deposit of graphite that has been worked systematically for a period of years, is the Dixon graphite plant at Ticonderoga." Another writes: "The Dixon plant at Ticonderoga has outclassed others and stands first, and produces flakes of such purity as to command the best prices."

There was a celebration one day in August, 1905, at Ticonderoga on the fort grounds, at which Mr. George B. Bascom, a resident of Ticonderoga and a well-known member of the Dixon mining family, was the chief orator. His recapitulation of history, character delinations and his reminiscence of old times in Ticonderoga were pronounced fine by those who heard. Indeed, they had to be, for it is one of the Dixon maxims that its men must do well whatever they do or quit. Bascom's speech was called AA1. Hurrah for Ticonderoga, renowned in history and by the Dixon graphite mines.

JOHN A. WALKER.

ELECTRICAL PATENT RECORD

LETTERS PATENT ISSUED OCT 17, 1905

Electric Railways and Appliances.

801,999. Trolley-Wheel. George Loffi, Newark, O. Filed Jan 7, 1905.

802,160. Trolley-Base. Charles E. Gierding, Newark N. J., asssignor to the Sterling-Meaker Company, same place. Filed Jan. 30, 1904.

802,173. Trolley-Harp. Edward D. Rockwell, Bristol Conn., assignor to the Liberty Bell Company, same place. Filed March 11, 1905.

Electric Lights and Appliances.

801,904. Electric Torch. John C. Perry, Columbia Station, O. Filed May 28. 1904.

801,939. Electric-Arc Lamp. Egidio Viale, Gross-Lichterfelde, Germany. Filed June 16, 1904.

Electrical Machinery and Apparatus.

801,850. Electrical Distributer for Gas-Engines. Lee S. Chadwick, Ridley Park, Pa, Filed March 26, 1903.

801,888. Alternating-Current Motor. Robert Lundell, New York City. Filed Jan. 9, 1905.

801,898. Electric Power-Transmission Device. Herbert McNulta, Anaconda, Mont. Filed Dec. 10, 1904.

801,932. Contact Device for Electrical Perforating Machines, etc. Daniel Stockman, Newark, N. J., assignor to G. Howlett Davis, West Orange, N. J. Filed Dec. 10, 1904.

802,052. Electric Coupling. Norman Marshall, Newton, Mass. Filed Oct. 26, 1903

802,130. Electric Measuring Instrument. Montraville M. Wood, Schenectady, N. Y., assignor to the General Electric Company. Filed May 29, 1902.

802,228. Current-Motor. Albert A. Morton, Walla Walla, Wash. Filed Jan. 27, 1905

802,246. Electrical Fuse-Plug. George B. Thomas, Bridgeport, Conn., assignor to the Bryant Electric Company. Filed March 17, 1905.

Telephones and Telephone Apparatus

801,851. Portable Telephone. Walter N. Clark, Warren, O. Filed Oct. 1, 1904.

801,864. Telephone System. Edward J. Hall, New York City. Filed Feb. 8, 1905.

801,936. Apparatus for the Simultaneous Transmission of Telephonic and Telegraphic Currents Over the Same Line. Carlo Turchi, Ferrara, Italy. Filed July 13, 1904.

802,015. Device for Attaching Telephone and Other Wires to Insulators. Esek McDaniel and Michael Barr, Paris, Ill. Filed March 23, 1905.

Miscellaneous.

801,947. Magnetic Separator. John P. Wetherill, South Bethlehem, Pa., and Henry A. J. Wilkens, New York City, assignors, by mesne assignments, to the Wetherill Separating Company. Filed Dec. 18, 1897.

801,967. Multiplex System of Telegraphy. George A. Cardwell, New York City, assignor to Joseph E. Heimerdinger, trustee, same place. Filed Feb. 3, 1900. Renewed Feb. 29, 1904.

802,093. System of Overhead Electric Conduction for Vehicles. Ettore Bauco, Rome, Italy. Filed Aug. 20, 1902.

802,170. Magnetic Ore-Separator. Richard R. Moffatt, Brooklyn, N. Y., assignor to the Imperial Ore Separator Company. Filed July 13, 1904.

802,201. Electric Sign. John L. Dawes. Pittsburg, Pa. Filed Dec. 1, 1904.

THE TELEPHONE WORLD.

Cut in Telephone Rates.

Officials of the New York & New Jersey Telephone Company have announced that beginning on November 1 next the rate from pay stations in Jersey City and Hoboken to other stations, public and private, will be reduced from 10 to 5 cents for each call.

Asked if the fact that the Coast Line Telephone Company, which was incorporated in New Jersey last June, inspired the New York & New Jersey Company in making the reduction in rates, an official of the company said the reduction was made to increase the business of the company in Jersey City and Hoboken. "The 5 cent rate," he said, "had been in operation in Bayonne and Union Hill for several months, and the increased business in these places warranted giving the residents of Jersey City and Hoboken a cheaper rate."

William F. Midlige, of Jersey City, a director in the Coast Line Telephone Company, said that, as counsel for the company, he will in a few days apply to the Jersey City authorities for franchises, and designate streets through which the Coast Line Company intends planting poles and stringing wires.

"We have already obtained 15,000 subscribers in Hudson and Essex Counties," said Mr. Midlige, "and I am sure that our success has frightened the officials of the New York & New Jersey Telephone Company into reducing their rates to retain their subscribers. I expect reductions will also be made in Newark."

The fight of the Independent telephone companies to enter Cincinnati, which has been in the courts for nearly two years, will come up for final hearing before the Supreme Court of Ohio November 1. The action grew out of the refusal of the city council to grant a franchise providing for the building of conduits, erecting poles and stringing wires in Cincinnati to the Cincinnati Telephone Company, the Interstate Telephone Company, the Queen City Telephone Company and the Fitzsimmons Telephone Company.

W. W. Tracy, ex-owner of the Hale Telephone Exchange, for the last two years manager of the system in Clarence, Mo., has sold his interest to W. E. Naylor, of Hagers Grove. Mr. Tracy has purchased the Shelbina telephone exchange and will take possession January 1.

The United Frederick & Clarke Telephone Company of Frederick County, Va., has the following officers: J. H. Funkhouser, president; P. M. Funkhouser, secretary and treasurer; J. S. Haldeman, stockholder. The capital stock is $1,000. Its objects and purposes are to maintain and operate a telephone line.

A special meeting of the Southern New England Telephone Company will he held November 1 in New Haven, Conn., to accept a legislative amendment to its charter which permits the company to issue $10,000,000 capital instead of $5,000,000 as at present.

The La Grange & Waldrick Telephone Company of Oldenburg, Tex., capitalized at $1,000, has lately been incorporated by H. Amberg, Louis Voelkel, Charles France and others.

Large Increase in Telephone Bonds.

According to the Census Bureau report on telephones and telegraphs for 1902, the total amount of telephone bonds then outstanding was $73,981,361. Up to that date while the total volume of telephone securities amounted to a par value of $348,031,059, the bonded indebtedness amounted to only 21 per cent. of this.

It was the policy of the early Bell financing to issue stock rather than bonds wherever possible with the result that several large Bell companies had no bonded debt or very little. Out of the total, the Bell companies had outstanding in 1902, $306,627,501 capital stock, and $65,673,272 bonds.

Since 1902 development has been very rapid, and one of the most remarkable changes has been the modification in the character of securities. It is probably safe to say that the bonds of the principal telephone companies now outstanding aggregate $150,000,000. The supply has doubled in three years, and 1902 stood at the end of a decade whose closing years saw an active telephone development.

This change appears to be largely due to the advent of the Independent forces.

Bell Service Will be Investigated.

At a recent meeting of the Griffin, Ga., city council, the Southern Bell Telephone & Telegraph Company was roundly scored by several members on account of the alleged obsolete 'phones and miserable service the company' giving to subscribers. A committee was appointed to investigate the matter thoroughly and report at the next meeting of the council, when some drastic measures may be taken to remedy the trouble.

The work of combining the Farmers' Mutual Telephone Company of Wellsboro, Pa., and the Citizens' Mutual Telephone Company of Mansfield, Pa., has lately been completed. The two companies have long worked in conjunction with each other, and now operate over 2,000 telephones in all directions in the counties of Tioga, Potter and Bradford.

Prof. H. A. Kinney, of Woodbine, Ia., president of the Southwestern Iowa Telephone Association, has called a special meeting of that association to convene at Council Bluffs on Saturday, October 28, for the purpose of discussing the clearing house movement for the Independent companies in the association.

The Cortland, N. Y., Home Telephone Company has begun the building of the line extending out to Groton avenue toward Groton City, a distance of about six miles. A large number of farmers will be accommodated by the new line.

The London "Economist" estimates that the British Government's telegraph system last year showed a deficit of $5,800,000 while the postal system earned a surplus of $52,800,000 for the same period.

The Odessa, N. Y., Telephone Company has been incorporated with the following directors: L. T. Couch, Wlliam Lattin and C. L. Frost, of Odessa.

Talk of Improving Service.

Representatives of the Mutual Telephone Company of Des Moines, Ia., lately met with the East Des Moines Commercial League, to discuss the advisability of improving the telephone service in that part of the city. Considerable benefit could be derived, it was believed, from the securing of a better service on the east side of the river, and the members of the Commercial League expressed their willingness to offer every encouragement toward the installation of a large number of 'phones and the general improvement of east side service.

Owing to the recent business growth of East Des Moines, it is expected that the Mutual Company will make a special effort to increase the number of subscribers by putting in a better service.

John I. Sabin, former president of the Chicago Telephone Company, died October 10 in San Francisco, Cal., after an illness of one week. Mr. Sabin, at the time of his death, was manager of the Pacific States Telephone Company. He was best known in Chicago as the promoter of the party line and nickel-in-the-slot telephone system, in connection with which he installed the multiple exchange system.

A new corporation has been organized by the citizens of Attica, N. Y., to be known as the Attica Home Telephone Company, for the purpose of erecting a telephone system and change there and connecting the same with the several towns and villages of Wyoming and Genesee counties and with the several Independent toll line telephone companies. George T. Loomis, Clarence H. Beane, W. A. Joiner, Elon P. Spink, Hugh Miller, Carlton D. Wing and Henry B. Flach are the directors. The capital stock of the company is $10,000.

A new telephone system, according to a recent report from Muskogee, I. T., is now being installed in the United States Indian Agency. It is called the intercommunication system. The Indian agent by merely pressing a button opposite the number desired acts as his own operator and can call up any office in the agency without appealing to "central.' Each office has a similar mechanical device, which gives the head of each department the same privilege of calling up any other office. Indian Agent Kelsey estimates that this system will save the Government hundreds of dollars in the time employed each year.

The Missouri & Kansas Telephone Company lately turned $1,773 into the Kansas City, Mo., treasury for the use of the streets during the last three months for its conduit system:

The work of stringing the cables for the Inter-Ocean Telephone Company in Danville, N. Y., is progressing rapidly and the system will soon be in operation.

The Commerce, Tex., Telephone Company has amended its charter, increasing its capital stock from from $5,000 to $10,000.

With a capital stock of $1,000, the Milan, Ind., Telephone Company has been chartered

GENERAL ELECTRICAL NEWS.

LIGHTING.

Avalon, N. J.—The borough council has employed an expert to formulate plans and estimates for the installation of an electric light plant here.

Byhalia, Miss.—This place is to have electric lights and waterworks. The new enterprise is under the management of R. D. Berry.

Dallas, Tex.—The mayor and city attorney are engaged in drawing up a contract with the Dallas Electric Company for furnishing this city with electric lights for a period of three years in accordance with the action taken by the council about the middle of the year. This contract will provide for the free lighting of the streets during the State Fair.

Fort Payne, Ala.—The manager of the telephone exchange has been working for some time to get a system of electric lights for this place and has about succeeded in his efforts. He has secured a sufficient number of customers to make the enterprise a success.

Greencastle, Pa.—Contractor Jacob Shank has started the erection of the power house for the electric light plant.

Greenville, Me.—The Greenville Light & Power Company is constructing a new and larger electric plant a short distance south of Wilson Pond, about three miles past here.

Hyattsville, Md.—W. P. Magruder, W. S. Holton, J. W. Aman and others have organized a company with a capital stock of $20,000 to erect and operate an electric light and ice plant.

Iron River, Mich.—The matter of issuing $30,000 of bonds for municipal improvement purposes will be voted on at a special election to be held here to-day. Of the amount it is proposed to raise, $20,000 is for the establishment of an electric light plant.

Mayo, Fla.—The town council has granted a franchise to Clarence H. Ellis and others for the right to put in a system of waterworks and an electric light and power plant.

Monroe, Mich.—George Gilsky, of Kalamazoo, is now manager of the municipal lighting plant. The city is to be entirely rewired and put on a meter system.

Nashville, Ill.—K. H. Steinhasuer has purchased the Nashville electric light plant from the present owners.

New Brunswick, N. J.—A call has been published for a meeting of New Brunswick business men to consider the feasibility of the establishment of an electric municipal lighting plant. The call is signed by 28 of the leading business and professional men of the city.

Ocilla, Ga.—This city has let a contract to J. B. McCrary, of Senoia, for the construction of waterworks and an electric light plant.

Paducah, Ky.—John S. Blecker, of Messrs. Stone & Webster, Boston, Mass., has secured the franchise to operate an electric light and power plant here.

Philipsburg, Pa.—The arc lights throughout the town are being replaced with new ones, made necessary by the new system being introduced by the Electric Light Company.

Pikeville, Ky.—The Pikeville Electric Light Company has been incorporated with a capital stock of $50,000 to operate an electric light plant.

Plains, Pa.—The people here are to have their own electric light plant in the near future.

Springdale, Ark.—This city has granted a franchise for an electric light plant to Spencer Owen, of Belgrade, Neb.

Streator, Ill.—This city is talking of putting in a public electric light plant.

STREET RAILWAYS.

Birmingham, Ala.—J. M. Dewberry and others have secured a franchise to build and operate electric car lines in Jefferson County

Bloomsburg, Pa.—It is now proposed to extend the Bloomsburg & Danville trolley line as far as Northumberland. For further information address W. S. Pascott.

Chambersburg, Pa.—The directors of the Chambersburg, Greencastle & Waynesboro Electric Railway Company recently went over the line on which the proposed road is to be built.

Davis, I. T.—J. C. Root, chief engineer in Kansas City, has been here surveying for the electric line to Turner Falls.

Davenport, Ia.—According to information given out by John Farson, of Oak Park, who is president of Farson, Leach & Co., of Chicago, this city is to have an electric interurban line, connecting with Chicago.

Eau Claire, Wis.—Three local capitalists, O. H. Ingram, B. A. Buffinton and John S. Owen, with others, have bought outright the street railway system of this city and Chippewa Falls, including the Eau Claire electric lighting plant.

Jonesboro, Ark.—Grading and other work will begin at once on the Jonesboro & Nettleton trolley line.

Los Angeles, Cal.—This city is soon to have another electric railway line, linking it with the Santa Monica beach and thence along the coast of Ventura County. Mrs. Rindge is at the head of the project.

Louisville, Ky.—The Louisville & Indianapolis Traction Company, incorporated with a capital of $10,000, by John R. Schindell, of Cincinnati, and Charles Redman, has been formed for the purpose of looking over the field with a view of building a line north from Jeffersonville.

Marshalltown, Ia.—Prominent business men of this city, Waterloo, Grundy Center and Newton have incorporated the Union Traction Company, the purpose of which is to build an electric line from Waterloo to Newton, through this city. The company is capitalized at $100,000, and will be promoted by H. L. Smith, of Indianapolis.

Morgantown, W. Va.—The Morgantown & Dunkard Valley Railroad Company will build a power house.

Pasadena, Cal.—Linda Vista, one of this city's suburbs, may soon have an electric railway.

Paterson, N. J.—It has been decided to begin at once the work of constructing the proposed new electric railroad from this city to New York and at the first meeting of the directors of the New York & New Jersey Rapid Transit Railway Company engineers submitted plans. They estimate that the cost of building the road will be about $8,000,000.

Philadelphia, Pa.—Pennsylvania Railroad officials, after an exhaustive investigation, have become satisfied that electricity is the coming motive power and have decided to electrify one of its two lines between Camden and Atlantic City, N. J.

Salem, Ore.—It may be announced definitely and authoritatively now that there will be an electric railroad built connecting this city with Portland.

Shelbyville, Ky.—It is announced that actual work of construction on the Shelbyville & Ohio River Electric Railroad, which is to run from here through Newcastle, Eminence and to Carrollton and Milton, will begin in a few days, bonds amounting to $1,000,000 having been floated to finance the construction.

Washington, D. C.—A. H. Semms, in behalf of himself and several capitalists associated with him, has obtained permission from the district commissioners to advertise the fact that they intend to offer a bill in Congress at the next session for the charter of a new electric railroad in the District of Columbia.

Waxahachie, Tex.—The city council has adopted an ordinance granting a franchise over the streets of this city for an interurban electric railway, to run from here to Dallas and on to Ennis.

POWER PLANTS.

Knoxville, Tenn.—The Oliver Company of this city has been awarded the contract to build the dam and power plant for the Tennessee River Power Company, about 30 miles below Chattanooga. The contract price is $2,000,000, or slightly in excess of that amount. Work on the monster project is to begin at once and will be rushed to completion.

Lockport, N. Y.—W. B. Skinner, of New York City, has been here working on the transmission line to Buffalo from this city for the Niagara, Lockport & Ontario Power Company. The line will run from Lockport to Pendleton along the Buffalo & Lockport tracks, thence to Getzville, then through the town of Amherst to Williamsville and thence to Buffalo.

BIDS WANTED.

Brooklyn, N. Y.—On November 1 bids for the contract for insulating the consolidated power plant will be received by Civil Engineer Hollyday. The plant will be installed in building No. 41 at the Navy Yard and the motive power will consist of compressed air, electricity and steam.

Washington, D. C.—The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until November 14 for furnishing the torpedo station at Newport, R. I., with the following: Schedule 188, conductor cable, testing magnets, copper wire, dry battery cells, keyboards for observation mines, firing battery and junction boxes. On November 21 the Bureau will open bids for furnishing Western Navy Yards with the following: Schedule 178, electrical fittings; schedule 179, motors. The Bureau will also receive sealed bids until November 28 for furnishing the Mare Island, Cal., Navy Yard with an auxiliary fire alarm system. The schedule number is 187. Prospective bidders can obtain blank proposals and detailed information of the above by applying to the Bureau at Washington.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 16⅜@16⅝c.; Lake 16⅜@16⅝c.; casting, 16⅛@16⅜c.

It is stated that about $2,000,000 New Haven, Conn., capital is invested in the Boston suburban lighting field.

The Automatic Electric Company of Chicago has declared the regular quarterly dividend of 2 per cent., payable November 1.

C. A. Coffin, president of the General Electric Company, has been elected a director of the American Locomotive Company.

The Northern Texas Traction Company has declared the regular quarterly dividend of 75 cents a share, payable November 1.

The Old Colony Street Railway Company of Boston has declared an annual dividend of 2 per cent. on its outstanding capital stock of $7,312,400.

The directors of the United Traction Company of Albany, N. Y., have declared the regular quarterly dividend of 1¼ per cent., payable November 1.

The City of Chicago has been granted permission to submit records in the street railway cases which are set for hearing by the U. S. Supreme Court on January 2.

The directors of the Cambridge (Mass.) Electric Light Company have declared a regular quarterly dividend of 2½ per cent., payable November 1.

Inside interests say that the Brooklyn Rapid Transit system will surely show gross earnings of $18,000,000 next year, and that such gross earnings would warrant the beginning of dividends.

The decrease in the earnings of the Manhattan Elevated Railway Company of New York, as shown in the annual report, was 7 per cent. as compared with the previous year. The management had expected a decrease of 20 per cent.

The Chicago Edison Company has sold electric current equal to 7,000 horse power on long contract to the Chicago City Railway Company. During the next two years the Edison Company plans to expend $4,000,000 in improvements.

Walter H. Whiteside, president of the Allis-Chalmers Company, denies emphatically that there is any truth in the rumors of contemplated absorption by the General Electric Company. Still there are others who believe "there's something doing."

From the maps filed by the Hudson Street Railway Company, which was recently incorporated, it proposes practically to parallel the trolley lines of the Public Service Corporation of New Jersey, now in operation throughout Hudson County.

There was a report in Wall Street Monday that the New York City Railway Company had sold $1,000,000 worth of mortgaged real estate to put the money in improvements, but had been forced to deposit the money with the trust company acting as trustee. This was authoritatively denied.

The New York State Gas and Electricity Commission has received application from the Kings County Electric Light & Power Company of Brooklyn for permission to increase its capital stock from $5,000,000 to $10,000,000 for the purpose of improving its plant. A hearing was set for November 17 at the commission's New York office.

ELECTRICAL STOCK QUOTATIONS.

Name.	Closing price Oct. 23
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	212
Manhattan Elevated Railway	166
Metropolitan Street Railway	126¼
Metropolitan Securities	81¼
Ninth Avenue	197
Third Avenue	125¾
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	77¼
Brooklyn City Railway	239
New Orleans Railway	38
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81¾
Philadelphia Traction	100⅛
Union Traction	62⅞
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	13¼
do. do. do. pref	56½
West End Street, com	99¼
do. do. do pref	114½
Chicago.	
City Railway	192
North Chicago	83
Union Traction, com	12¼
do. do. pref.	43¾
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com.	20¼
do. pref.	63½
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	16½
do. do. pref.	22
Westinghouse, com	177¼
do. pref.	197
General Electric	189¾
Boston.	
Edison Electric Illuminating	248¾
General Electric	190
Westinghouse Electric & Mfg., com	85½
do. do. do. pref.	100
Chicago.	
Chicago Edison	163
National Carbon, com	62¼
do. do. pref.	115
Philadelphia.	
Electric Company of America	11⅛
Electric Storage Battery, com	84¾
do. do. do. pref.	84¾
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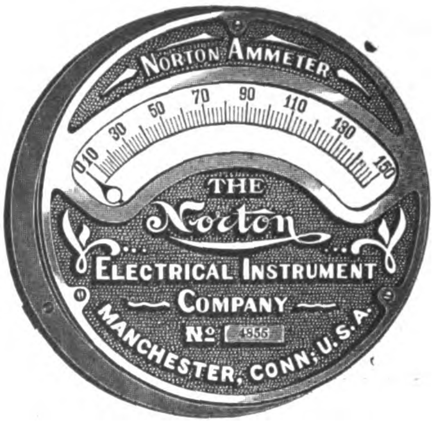
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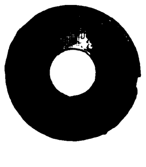

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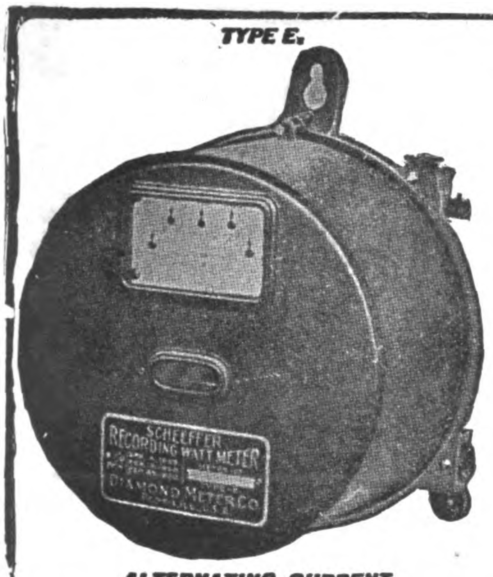
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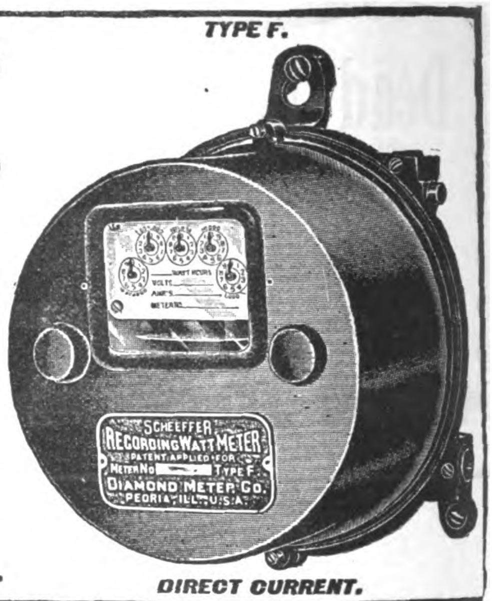
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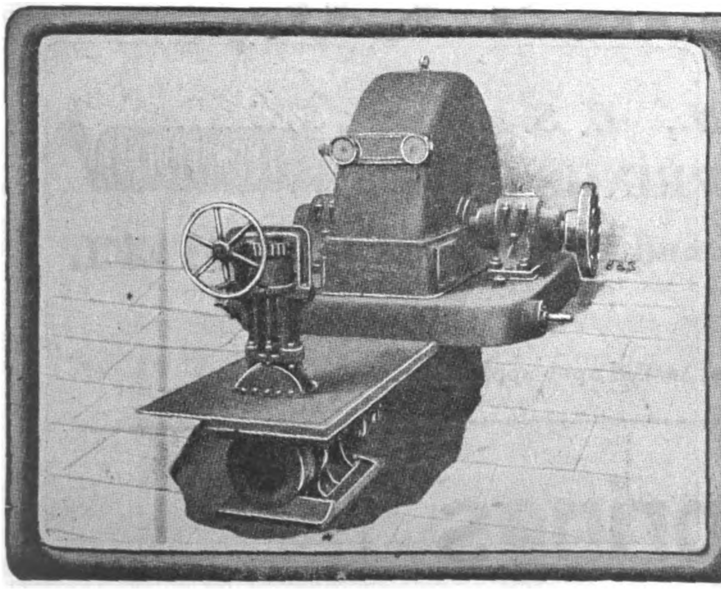

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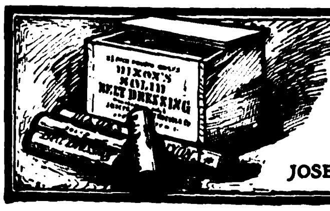
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EDITORIAL NOTES.

Cities Doing Their Own Electric Lighting.

One way of looking at municipal ownership is to look at the record it has already made. Another is to examine the principles upon which it is supposed to rest as a working theory. If the general public were sufficiently well acquainted with both it is unlikely that so many would express opinions indicative of sheer ignorance on the subject. At its best, it is a question which cannot be settled by a public vote, for the self-evident reason that the voters, unless people of the highest acumen, are merely guessing. So grave a matter as saddling a community with the legal and financial responsibility of an industry is no different from that of buying a shoe factory, to make shoes for the public when they walk the streets. It is not very different from that of running a large bakery, because everybody must eat bread. It is, in certain respects, the thin edge of the wedge of socialism, which, beginning with one thing, will not and cannot end theoretically until it has embraced all things representing public needs.

It is, of course, only one item that is to be considered—the lighting of the city streets and public buildings. Yet how complicated a business so simple an item represents. If the present corporations doing electric lighting have had to invest millions of dollars and spend years of time in experiments, which not only yielded the present efficiency of operation, but what is more important, perhaps, yielded the present experience in this great industry, what will the city do to conduct its business properly? Is it reasonable to suppose that it can succeed in such an enterprise, and prosper to the same extent, without going through the same money-burning experiences? It is widely admitted that experience costs money, and whether it is in shoemaking or breadmaking, there is that something to be learned to make it a success. But this is not all; there is also a large investment to be considered.

Juggling facts and figures will not remove the conclusion that where a large investment is made it must yield a reasonable profit. Such a sum, when put into operation, must produce what is expected of it. If it partly represents machinery, its earnings must include depreciation. Wear and tear are important items of expense, which must be considered as well as other things.

It is, of course, impossible to take up this subject from a clerical point of view without referring to the necessary items constituting it. But the rough outlines of the proposition can be noted, and then such facts as are pertinent to municipal ownership with respect to its present results in American practice.

To begin with, one of the fundamental principles of progress in the industries is that competition is the first and only stimulating cause. Remove competition and every step forward becomes an effort. In electric lighting, competition and scientific advance have been the moving forces. Under the rule of municipal ownership no contrasts can be made, either as regards machinery or system employed, that would not be regarded as a political move to invite a new and unnecessary expense. The political feature, therefore, would condemn it from this standpoint, as well as that of its opportunity to provide positions of political preferment. Thus, the destruction of competition and the creation of a new source of political revenue are the features militating against it.

The immense cost is the next point; not only as an expenditure of money, but as a form of investment that represents a constant depreciation. The public may think that electric lighting is a very profitable business, but like any other large business, its profits are the result of enormously heavy investments and years of persistent effort. Laying down a million dollars' worth of copper underground means not only this but a great labor bill in addition. The companies using subways have done it, and anyone else must do the same. But even in duplicating the moves of corporations the city does not necessarily save itself.

The Detroit plant is spoken of by Mr. M. J. Francisco, who has thoroughly investigated this subject, as a case of "gross underestimates of cost and incorrect figures for depreciation." In Massachusetts and Connecticut a law had to be passed forcing managers of electric light plants to estimate depreciation at 5 per cent. In other words, the reports of municipal plants from all over the country, almost without exception, show an exaggerated tendency in this direction. Underestimates of cost and depreciation are to-day the real foundations for a belief that a city can do its own electric lighting cheaper than it can buy electricity. How many instances arise in private business where the temptation to save in a certain direction is recognized by the far-seeing and shrewder class as a delusion and a snare. The manager of the municipal plant in Detroit will not admit the rate of depreciation fixed by law in other communities as being true in their case. Therefore they present reports leaving out important items of expense to prove success. Not only is this true of Detroit, but of other towns and cities trying the experiment. But even admitting this to be true, what will be the cost of this lighting when the entire plant must be thrown out to make way for the newest and best in the line? What will such an item be when compared with the saving previously calculated?

* * *

Electric Surges in Power Stations. Electric surges in power stations arise through the sudden rupture of a circuit, through the fuse blowing, or the switch being opened too suddenly, which controls a large quota of power. To those versed in the technics of resonance it is well known that a certain relationship between the self-induction, capacity and resistance of a circuit, will create oscillations and high pressures of a character dangerous or not, depending upon the influence they have upon the insulation. The sudden breaking of a power-carrying circuit, whose capacity and inductance express such a relationship that the ohmic resistance offers a free path, may mean the development of a pressure sufficient to burst through the regular insulating covering at some point or other, and start a destructive arc between two cables.

But electric surges are caused directly by what may be termed the sputtering of an arc in a circuit. They make and break the circuit at some important point and develop the class of surges spoken of—tremendous tidal waves of electricity which roll back and forth in the circuits and station, wrecking machinery and burning out cables.

Resonance is allied in certain respects to these surges. More, however, because they are fundamentally alike, than because they can be otherwise identified. In circuits with resonance, should such a misfortune occur, the self-induction and capacity do not appear. But the current will develop a pressure due to this condition that may break down the insulation and cause such surgings to occur, through the arc formed at the point of rupture, as to threaten the entire system. Opening every main switch in such an instance is the only means of providing an immediate relief from the dangers of widespread destruction.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

There are at present over 6,000 accident suits pending against the Metropolitan Street Railway Company of New York, and the company has determined to fight to a finish a gang of "habitual fake-accident suit bringers."

The formal opening of New York City's lighting plant under the Williamsburg Bridge took place Monday afternoon. Mayor McClellan turned the switch which will light up the bridge and the plaza at the Brooklyn end of the structure. The new plant will furnish power for the electric pumps in use at the stations on either end of the bridge. It includes four generators. The cost of the plant, which will burn refuse from the streets, was approximately $60,000.

A cable dispatch from Munich, Germany, says that Prof. Korn, a leading electrical inventor of that city, claimed in a lecture before the Eletrotechnical Association that the problem of transmitting photographs by telegraph had been solved in principle, and it was now possible to transmit a photograph or sketch six inches square in from ten to twenty minutes. This was done over a telegraph line between Munich and Nuremberg, but was equally practicable over 5,000 miles. The photograph to be transmitted is placed in a transparent glass cylinder which revolves slowly, at the same time moving from right to left. A ray of electric light is thrown upon the cylinder and lens, and when the ray reaches the interior it is brighter or darker, according to the coloring of that particular part of the photograph through which it passes. Inside the cylinder is some selenium, which transmits an electrical current in proportion to the intensity of the light brought to bear upon it. This selenium is connected with a wire over which the photograph is transmitted.

An organization known as the "Open Shop" Electrical Contractors' Association of Boston and vicinity has been formed in that city for the purpose of fighting the electrical workers' union.

The Fort Wayne & Wabash Valley (Ind.) Traction Company is offering to sell power to farmers within a certain distance of its lines for operating machinery. This experiment is being watched closely by power companies all over the country.

The "Lancet," a well-known weekly paper of London, says it has "discovered" that the atmosphere of the Metropolitan Underground Railway of that city is charged with ozone, created by the multiple electric discharges which take place on the live rail, and adds "that it would have been considered a bold seer who a few years ago had prophesied that the time was coming when not only would the output of evil gases on the railway be stopped, but that they would be replaced by inodorous and ozonized atmosphere."

London, England, is now able to call up Rome, Italy, on the telephone. The two cities are 1,100 miles apart.

Electricity is to be put to a novel test by the Department of Agriculture at Washington, D. C. A laboratory is being fitted in the division of pathology for the purpose of conducting experiments in the growing of plants by the aid of an electrical appliance. The experiments are based on the theory that the growth of vegetable matter, which ceases at sundown, will continue through the night if proper artificial light is supplied to stimulate the natural developing power of the plants.

ONE VS. TWO DYNAMOS FOR A THREE-WIRE SYSTEM.

BY W. H. WAKEMAN.

Fig. 1 illustrates a right-hand dynamo, viewed from the end of shaft on which the commutator is located. When standing at this end and noting the armature as it revolves it turns in the direction traveled by the hands of a clock, as indicated by the arrow.

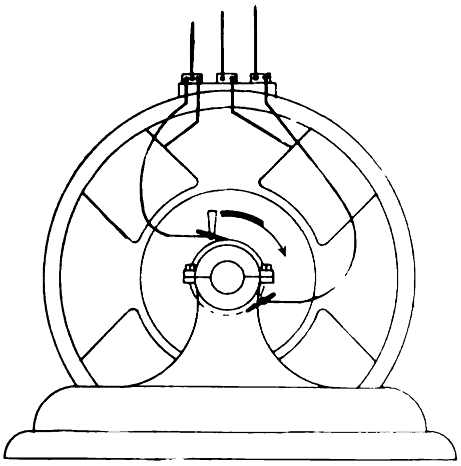


FIG. 1.

Fig. 2 is a left-hand dynamo, and it will be noted that the armature revolves in the opposite direction from the preceding. In other words, a right-hand dynamo revolves clock-wise, while a left-hand one turns anti-clock-wise. In both cases the observer stands at the commutator end of shaft.

Several years ago a dynamo was purchased for my plant and when it arrived I found that it was a right-hand machine, but owing to local conditions it was necessary to use a left-hand type.

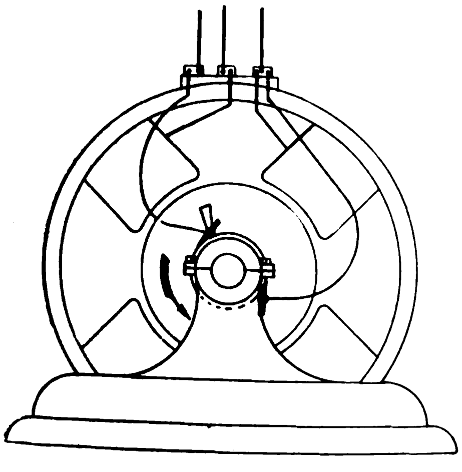


FIG. 2.

As it was fitted with carbon brushes it was possible to run it in either direction without making any permanant change whatever, but the brushes would not look natural nor run to the best advantage because the commutator bars would be running "against the brushes." The meaning of this expression may be explained as follows: These brushes were set at an angle, as shown in both of the illustrations, and when the armatures turn, as indicated by the arrows, they run "from the brushes," but if they turned in the opposite direction they would be revolving "against the brushes."

In my case the brush holders were taken off and turned so as to hold the brushes in the opposite direction.

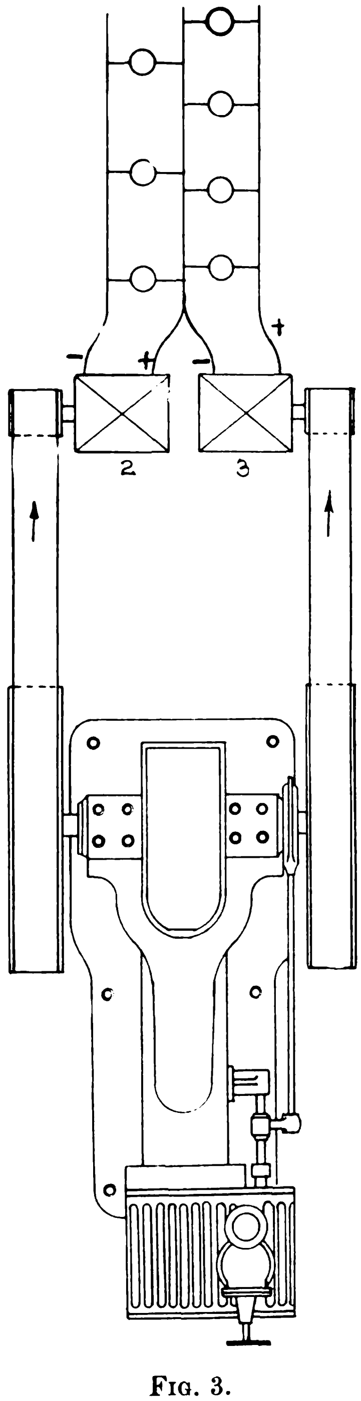


FIG. 3.

Careful consideration of these facts shows that the only essential difference between a right and a left-hand dynamo is that they revolve in opposite directions.

The case is different with a steam engine, as the frame is either made or used different for a right than for a left-hand machine. When you stand at the cylinder head and look towards the crank, if the fly-wheel is on the right hand side it is a right-hand engine, but if located at the left it constitutes a left-hand machine. Some engine builders adopt a different design of frame for each kind, while others simply use them different as they are either right or left-hand, according to which side is uppermost. Of course this does not apply to a center crank engine in which both sides are alike.

Where a three-wire system is to be installed it is customary to use two dynamos, as illustrated in Fig. 3. These are driven by a center crank engine of suitable size using a fly-wheel on each side. Arrows on the belts indicate the direction in which the tops of both belts are traveling.

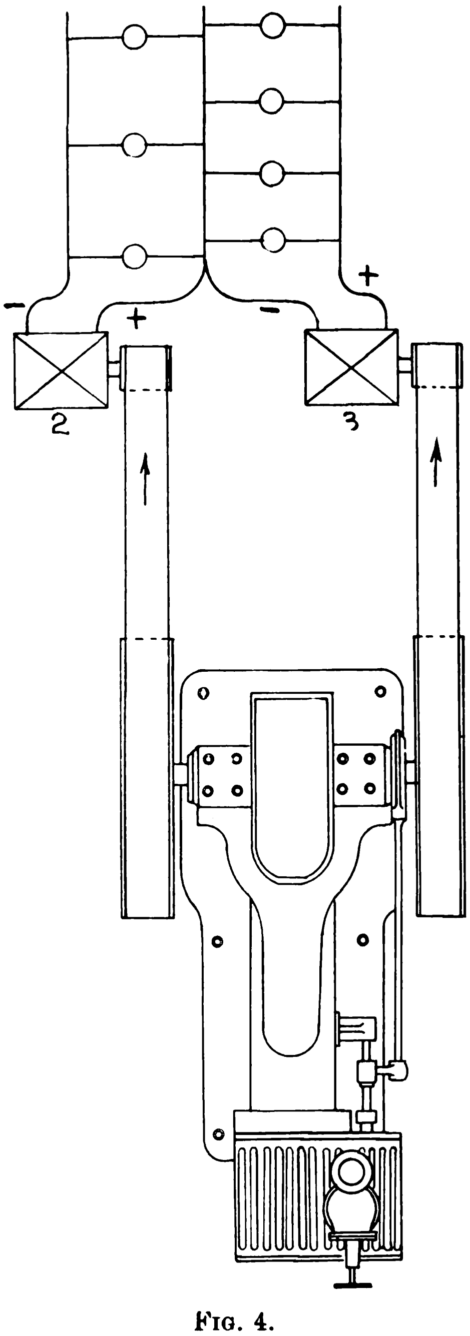


FIG. 4.

In this case 2 is a right and 3 a left-hand dynamo, and as both are driven by the same engine they will run at the same speed, as long as both belts are in good condition for service.

In some cases it may be desirable to arrange the machinery as shown in Fig. 4.

The arrows indicate the direction of rotation as before, but now both 2 and 3 are left-hand dynamos. In both cases more lamps are on one side of the system than on the other, in order to show that it is not balanced, therefore the middle wire returns a small amount of current to the dynamo 3.

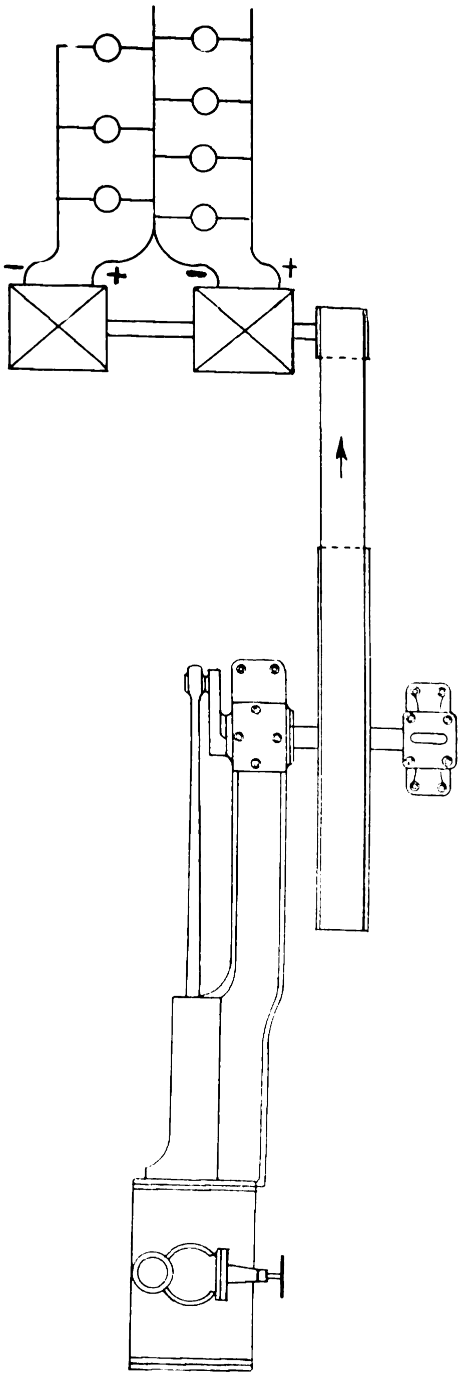


Fig. 5.

Inasmuch as it is desirable in some cases and necessary in others to drive two dynamos at equal speed, why not locate them both on one shaft, as shown in Fig. 5, and use a better type of engine with one fly-wheel and one belt? The wiring system may be balanced or not, according to requirements, with equally good results. As the armatures are rigidly connected they must operate alike whether the belt slips or holds perfectly.

Passing on from this arrangement to Fig. 6 we have one dynamo supplying current to a three-wire system, making a very simple plant from which good results may be expected. While such an arrangement may not be commonly used there is no good reason for calling it impractical, as a careful consideration of the illustrations will plainly show.

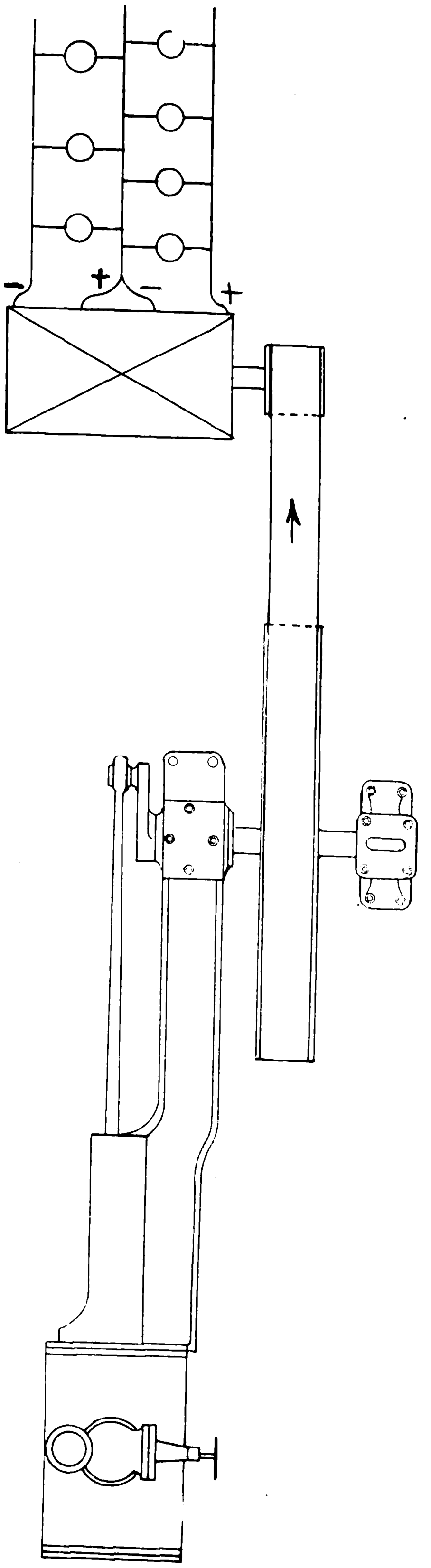


Fig. 6.

Fig. 7 is an elevation of a dynamo designed to generate electricity at two different potentials, thus showing that it is quite possible to devise and execute almost any plan relating to the generation and use of this most subtile and elusive means for retransmitting power. In fact it is more dangerous to state that any desired result cannot be secured with it than to claim the possibility of doing unheard of things, because enough is known by true scientists to make a great many things possible that have not yet been demonstrated in a practical way, and very few electricians are willing to say that we fully understand electricity at the present time.

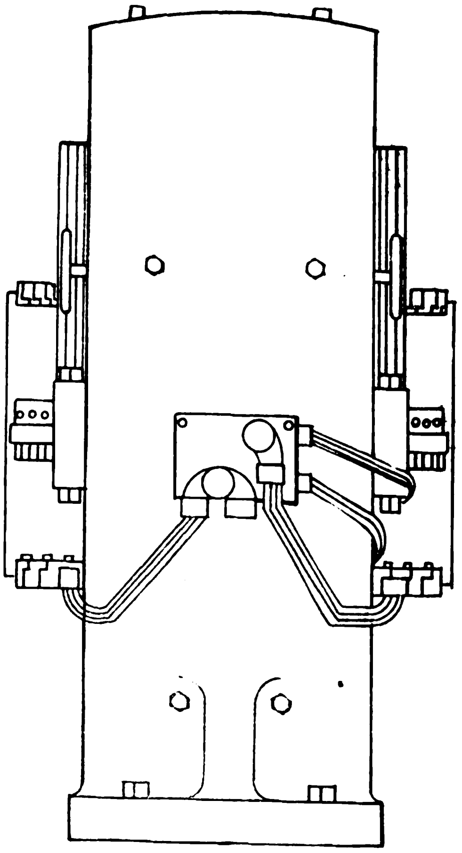


Fig. 7

Rash enthusiasts have prophesied some things that are not yet in evidence, and may never be, but who shall decide which particular thing can never be accomplished after reviewing the progress made during the past ten years?

DOMESTIC ELECTRIC LIGHTING.*

BY JAMES SWINBURNE, M.I.E.E.

On October 6 Mr. James Swinburne delivered an interesting lecture at the Electrical Exhibition, Olympia, London, on the "Lighting of Houses by Electricity," of which the following is an abstract. The lecturer mainly confined himself to a description of the various types of electric lamp and the advantages of the use of electric light in comparison with other methods of illumination.

After mentioning the early work of

---

*From the "Electrical Engineer," London.

Sawyer and Mann, Edison, Maxim and Swan, the lecturer pointed out that the carbon incandescent lamp is to-day practically identical with the lamp suggested in 1836 and successfully made in 1880. The improvements made in these lamps are really improvements in detail of manufacture and standardizing, which have fortunately rendered lamps much cheaper. Important improvements have been made in the method of blowing the bulbs of the lamps. In the early days bulbs were blown by hand; since then, however, the Germans have invented a method of blowing lamps by machinery, in a manner practically identical with that used in making bottles. The exhaustion of the lamps is now generally performed by the aid of a mechanical pump, although the vacuum obtained in this manner is not so good as that found in the earlier lamps. The method of "flashing" filaments invented by Maxim, but generally ascribed to Sawyer, has rendered it possible to obtain lamps which are practically uniform.

Before proceeding to describe the more modern form of electric incandescent lamps, Mr. Swinburne gave an interesting discussion on the relative cheapness of electric light and gas light. In the early days, when the luminous gas flame was used, electricity supplied at the cost of 3d. per unit would have been equal to gas supplied at 2s. per 1,000 cubic feet. This estimate ignores the cost of lamps. At the present day the use of mantles has very much cheapened the cost of gas light. Gas companies say that gas is about 30 times as cheap as electric light, but Mr. Swinburne calculated that the cost of gas was about nine times as cheap as electric light. This, however, is only one side of the question. If cheapness were the only consideration, it would be best to light a house up by providing a large fire in the middle of each room; but, of course, the fumes from the fire would do so much damage to the house that this method would be quite impracticable. The fumes from gas, although not so obnoxious as those from a fire without a chimney, are nevertheless very damaging; a house lighted by gas needs redecorating every four years, while with electric light it would not need redecorating more than once in six years. If you take a house in London and use electric light, and thus render it possible to redecorate it every six instead of every four years, the economy in redecorating will just counterbalance the extra cost of the electric light. In addition, the injury done to leather-bound books, and the extra cost for servants necessitated by the tarnishing of plate, when gas is used, need to be considered. Taking everything into consideration, the electric light would be cheaper than gas for lighting purposes, even if the gas companies would supply their gas for nothing. Mr. Swinburne referred to the fact that light is obtained more economically if the carbon-filament lamp is "over-run," but over-running means a shorter life for the lamp. Most householders run their lamps at too low an efficiency, and also for too long a time. In many cases lamps are still used in houses after they have become so blackened that a large percentage of the light emitted by the filament is absorbed.

Whithin the last few years several improved forms of incandescent lamps have been put on the market. The first of these was the Nernst lamp. In this lamp zirconia is used as the basis of the conductor to be heated by the electric current; its high melting point renders it possible to raise the conductor to a much higher temperature, and therefore to obtain light which is both more economical and more like sunlight. The worst thing about these lamps is that they give a good deal of trouble. When switched on they do not light up at once, since a current has to be sent through a heating coil in order to raise the temperature of the glower to the point when it becomes conducting before the electric current can pass through the glower. This is sometimes very annoying. For instance, a man goes down to his wine cellar where a Nernst lamp is in use; he turns on the switch and nothing happens, when he probably says something and lights a match, gets what he wants and goes away. Afterwards the lamp lights up and burns until someone again visits the cellar. On going into a dark room you will probably have to wait a quarter or half a minute before you can get a light. In the latest types of Nernst lamps small carbon-filament lamps are provided, which become luminous when the Nernst lamp is switched on, and when the Nernst lamp lights up the subsidiary lamps are switched out automatically.

One of the latest forms of electric incandescent lamp is the tantalum lamp. Tantalum is a metal which is not in general very well known. It is nearly or quite as hard as the diamond, and rather stronger than steel. The German firm of Siemens & Halske have succeeded in shaping this metal into very fine filaments and making these into lamps. The high melting point of tantalum renders it possible to raise the filament to a much higher temperature than would be practicable in the case of carbon filaments, and thus greater economy is effected. In addition, the resistance of tantalum increases with the temperature, while the resistance of carbon remains stationary, and under certain circumstances decreases with the rise of temperature, with the result that an accidental rise of pressure that would destroy a carbon filament has no harmful effect on a tantalum filament.

Were it not for the high price of tantalum lamps, carbon-filament lamps would no longer have a chance against their latest rival, but when a carbon-filament lamp can be obtained for a few pence people are loth to pay three, four or five shillings for a tantalum lamp, however great its advantages may be.

The osmium lamp was invented by Auer von Welsbach, the inventor of the gas mantle. Osmium is about as rare as tantalum and about as difficult to work. The osmium lamp is a very promising lamp, indeed, but the difficulty is to obtain a filament long enough and thin enough to possess a sufficiently high resistance for the ordinary pressure at which electricity is supplied. However, lamps have been made to withstand a pressure of 110 volts, and two of these may be coupled in series across 220-volt mains. The osmium lamp has the further advantage that very efficient lamps can be made from it to run at very low pressures, even below 50 volts. Portable osmium lamps lighted by means of a secondary battery have been supplied by the Electrical Power Storage Company; these should be very popular, as they can be turned on at an instant's notice wherever they happen to be wanted.

The Cooper Hewitt lamp utilizes the light emitted when an electric current passes through mercury vapor. In its original form it was unsuitable for domestic lighting, since the color of the light emitted is something between green and blue, and would render the most beautiful lady's complexion hideous. It is, however, excellent for use in drawing offices, and it is being used with great success in photography. It has a very high efficiency—that is, it dissipates very little power in proportion to the light which it emits. Mr. Bastian has invented an improved form of mercury lamp specially arranged for domestic lighting; a carbon-filament lamp is run at so low a pressure that it only emits red light, and this combined with the blue and green light from the incandescent mercury vapor forms a very good light indeed. This lamp brings the cost of electric light down to that required in the case of gas, without taking into consideration the deleterious effects of the latter.

LIGHT, HEAT AND POWER PRINCIPLES.—VI.

BY NEWTON HARRISON, E. E.

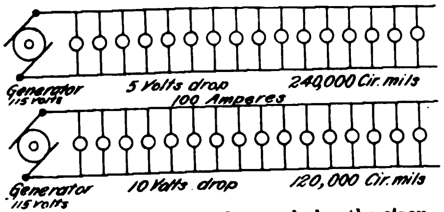
Distribution by Wire.—The direct and alternating current are combined in all large schemes for the transmission and distribution of electrical energy. The reason why a distinction is made between the two processes is because one is, as its name implies, merely distribution. For this reason the machinery employed is not the same as that used in transmission. The other being transmission calls for a system which will give flexibility, efficiency and economy in installation. Both the two and three wire systems of wiring may be utilized, although direct and alternating current respectively are employed—largely direct for the two and three-wire, and generally alternating for the two-wire system only. The direct current system of lighting is one whose distribution takes in the two and three-wire; the calculations of wire sizes being based upon the following simple rule:

Size of wire in circular mils = amperes × feet of wire × 12 ÷ volts drop. For instance, a line carrying 100 amperes with 5 volts drop through 1,000 feet of wire, would require a size of wire equal to 100 × 1,000 × 12 ÷ 5 = 240,000 circular mils. For one-half the drop in volts the size of wire in circular mils is doubled. For one-quarter the drop, the size of wire in circular mils is quadrupled as follows:

TABLE SHOWING THE CHANGE IN CIRCULAR MILS WITH CHANGE IN DROP.

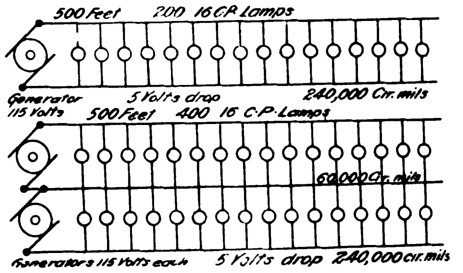
Amperes.	Volts drop.	Length of wire.	Size of wire necessary in circular mils.
100	5	1,000 ft.	240,000
100	2.5	“ “	480,000
100	1.25	“ “	960,000
100	10.00	“ “	120,000

The last line of figures, showing the halving of the size with a 10 volt drop, is given for the purpose of showing how flexible a matter the quantity of copper used may be, with respect to the drop.



Effect of doubling the drop to halve the circular mils.

A Two and Three-Wire System Contras‘ed.—The purpose in using three-wire instead of only two, is for the advantage gained in the amount of copper employed, and the better development of an electric light system so based. It has been shown that in a simple two-wire system the amount of copper is entirely dependent upon the degree of loss sustained. The more willing the proprietors of a plant are to sustain a loss in power, in distribution, or in transmission, the less correspondingly is the amount of copper required. But in all such instances, if the saving in copper is ten, twenty or even fifty thousand dollars, while the cost of the wasted power is, in the aggregate, after a few years have passed, an equal amount, then the saving and the cost are equal, and a new period is reached, where the loss through wasted power brings no compensation. Economy practiced in this direction, is therefore a failure in electric light and power work. But in a three-wire system, the drop can be regulated just as well as in a two-wire system, subject to the option of the designer of the circuit. A three-wire system carrying the same amount of energy as the two-wire can do a greater amount of lighting with less copper in proportion. For instance, in a two-wire system with a 5 per cent. drop as specified, on the basis of ½ ampere per 16 cp. lamp, the 100 amperes would light 200 lamps in a straight bank. But the size of wire would be 240,000 circular mils for the 1,000 feet of wire. On the other hand, if the 100 amperes are sent through a three-wire system, as illustrated, the result would be the lighting of 400 lamps with only the addition of a single wire to the circuit. This single wire in the middle need not have the cross-section of the others. It can be a wire of one-quarter the size, if some reasonable guarantee is given that the lamps are equally distributed on each side of the neutral wire. On this basis, the circular mils of the two-wire system are exceeded only to the extent of the copper in the neutral wire. The drop need not be greater, although double the voltage is used. By the same rule, in estimating sizes of wire, the circular mils equal 100 × 1,000 × 12 ÷ 5 = 240,000 for the two outside wires. The fact that 1,000 feet of wire are employed, is proof that the run is only 500 feet in length. But the 5 volts drop is now divided up between two lamps, and amounts to only 2½ volts apiece. In other words, the 100 amperes and double the pressure, when sent through a three-wire system lighting 400 lamps of ½ ampere apiece, can do this lighting with the same drop in volts between the terminals. It is now carrying double the load, with the addition of a 500 foot wire of 60,000 circular mils. The middle wire only takes up the difference in current between one-half of the lamps on one side and the other. Its size may be even smaller than that recommended, when a perfect circuit balance is established.

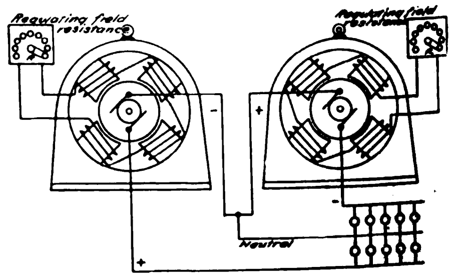


Comparison of two and three-wire system, with equal current in each, but double the lamps in the three-wire.

TABLE SHOWING THE CIRCULAR MILS OF A THREE-WIRE SYSTEM.

Lamps.	Amperes.	Volts drop	Length of wire.	Size of wire in circular mils, including one-half the neutral wire.
400	100	5	1,000 ft.	240,000 + 30,000 = 270,000
400	100	10	1,000 ft.	120,000 + 15,000 = 135,000
400	100	2.5	1,000 ft.	480,000 + 60,000 = 540,000
400	100	1.25	1,000 ft.	960,000 + 120,000 = 080,000

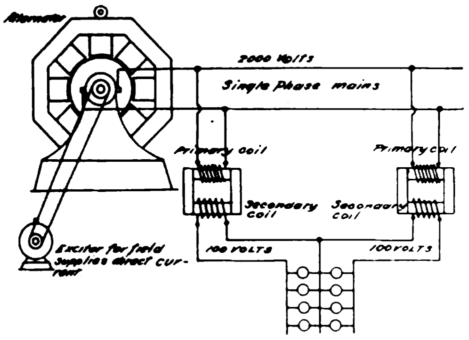
In each case one-quarter of the circular mils of the outer wire were taken as the size of the neutral, and one-half added to give the final figures in the last columns.



The three-wire system with generator field regulation - direct current.

Considering the fact that 400 lamps can be lit, it will be readily perceived that the increase in copper is not great enough to make the difference in wire sizes a matter of much consequence. The system in use for direct and for alternating current is illustrated with respect to the generator connections in one case and the transformer connections in the other.

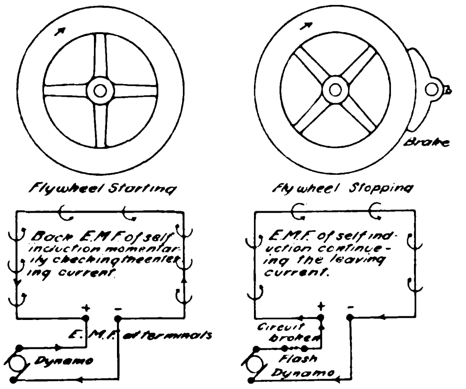
The Power Factor.—In single-phase systems, or in fact any system using an alternating current, the energy sent in does not necessarily appear in its full value. The illustrations showing the three-wire direct and alternating current systems differ in this respect: that in direct current the total watts are equal to the product of the volts and amperes. In the alternating current the watts are equal to the volts × amperes multiplied by a determining power factor. The fact that the circuit may develop inductive action, and thereby accentuate the conditions through which the volts and amperes do not entirely co-operate, has been the reason why it must be considered. It is the cosine of an angle, or a measure of the degree to which the co-operation is lacking between the volts and amperes. Its importance in power calculations confined to alternating currents is such that they are not comprehensible unless defined according to the imits it imposes. The following explanations will clear the way for conclusions relating to the elements of pressure, current and the extent to which they cooperate.


Alternator
2000 Volts
Single Phase mains
Primary coil
Primary coil
Secondary coil
Secondary coil
Exciter for field supplies direct current
100 VOLTS
100 VOLTS

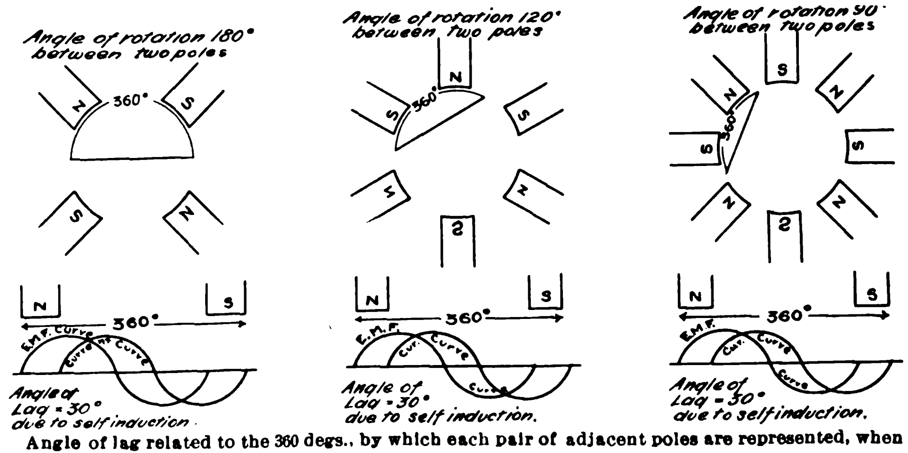
The three-wire system with single-phase current and two transformers connected for 3-wire lighting.

Angle of Lag.—That which is called self-induction causes the current to lag behind the electromotive force. By this s meant, that although the electromotive orce of the current passing into the circuit is operating upon the said circuit, it cannot instantaneously cause a current to flow. An interval of time elapses which is greater or less, according to the degree to which the opposing influence of self-induction exercises its influence. The meaning of self-induction, as a physical fact, apart from the symbol L by which it is generally represented, is obtained by a consideration of the fact that lines of force surround the circuit or leave it, when a current enters or eaves.

Self-Induction.—The self-induction developed in the circuit is therefore measurable by the lines of force embracing it, and the time they take to either surround or leave it. In certain respects, when a current of electricity flows through a circuit it is equivalent to that circuit being plunged into a magnetic field in such a manner as to produce electromotive force. The fact that the entering current is temporarily checked is due to the opposing electromotive force of self-induction. The conditions are similar to those which appear when a wheel is set into motion and then stopped. Inertia must be overcome to start the wheel, and it must also be overcome to stop the wheel. So in the same sense every electric current develops an electrical inertia to the entering current, and likewise develops an electrical inertia when the current reaches its exit. Though called self-induction it is quite evident that the entering current must meet and overcome an opposing or counter electromotive force. It is also evident that a retreating current cannot be checked instantaneously. These two phenomena are characteristic of all currents, and may be illustrated as described, by reference to a fly-wheel started and stopped, in comparison with a circuit being embraced and disengaged by lines of force.


Brake
Flywheel Starting
Fly wheel Stopping
Back E.M.F. of self induction momentarily checking the entering current
E.M.F. of self induction continueing the leaving current.
+
-
+
-
E.M.F. at terminals
Dynamo
Circuit broken
Flash
Dynamo

Simile of the inertia overcome in starting and stopping a fly-wheel to an electric circuit in which the current is sent in or cut off.


Angle of rotation 180° between two poles
Angle of rotation 120° between two poles
Angle of rotation 90° between two poles
360°
N
S
360°
EMF. Curve
Current Curve
Angle of Lag = 30° due to self induction
E.M.F.
Cur. Curve
Angle of Lag = 30° due to self induction.

Angle of lag related to the 360 degs., by which each pair of adjacent poles are represented, when an alternating EMF. and current are generated.

Lines of Force Surrounding a Circuit.—As long as lines of force are increasing around a circuit, the circuit will continue to develop EMF., but when the circuit is broken, or the current stopped the lines of force are disengaged. This phenomenon is accompanied by the development of another EMF. In other words, to make this fact more evident, when the current is entering the circuit the opposing EMF. of self-induction lets the current in only in a gradual manner comparatively. While only a fraction of a second elapses altogether, the reaction of the circuit takes time to subside, and in subsiding permits the EMF. trying to send a current through to perform its office. Thus the lag of the current behind the EMF. is an element of time though mathematically represented as an angle. The angle is readily explained by reference to a two-pole dynamo, or the two adjacent poles of an alternator.

Meaning of Angle of Lag.—In a two-pole dynamo, the circumference represents 360 degs. A conductor will pass through 180 degs. in passing each pole and one-half of the interpolar space between the pole pieces. If an alternating current is generated by this machine, then the conductor generating EMF. will have moved a slight distance before the current in the armature circuit responds. This interval of time corresponds to the angle through which the conductor moves. In the two adjacent poles of an alternator, the same condition of affairs exists, except that the arc embraced by the two poles is giving a valuation of 360 degs.

The angle of lag is therefore a period of time which elapses before the current flows, and is represented by an angle forming a distinct percentage of the assumed 360 degs. subtended by the pole pieces. For instance, if the alternator is four-poled, then a pair of poles representing on this basis 360 degs. would actually subtend only 180 degs. A six-pole alternator would mean only 120 degs. for two adjacent poles; but according to this standard, they would also represent 360 degs. from the beginning of the EMF. wave to the end of its complete reversal. This idea is represented in a series of alternators of 4, 6 and 8 poles with special reference to the angle of lag. The conditions would imply an equal amount of self-induction in each case, so that the angle of lag is equal throughout. In such a case, although the angle of rotation varies in the case of a 4, 6 or 8 pole machine, the angle of lag does not vary if the peripheral speeds are alike.

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NOTE ON LIGHTNING ARRESTERS ON ITALIAN HIGH-TENSION TRANSMISSION LINES.[*]

BY PHILIP TORCHIO.

During a recent trip abroad the writer inspected several high-tension transmission lines in Italy, and found that American lightning arresters with choke coils are quite generally used at the ends of the lines. In addition, Siemens horn arresters are sometimes installed at the ends of the line and at intervals at poles along the line.

The protection furnished by these devices, however, is not considered sufficient, on account of their inability to protect the line and the machines under all conditions of lightning discharges and surges, or even static disturbances caused by load fluctuations in the ordinary operation of the system. Transmission engineers have found it necessary to supplement the ordinary lightning arresters with some other protection, and to that end a variety of devices has been developed on different installations. Among these the so-called "series lightning arrester" of Gola and the "water resistance static discharger" call for special attention.

It is claimed by Gola that the shortcomings of the ordinary lightning arresters are due to some deficiency in the choke coils employed and not to any deficiency in the lightning arresters themselves, their function being only to discharge the line. To overcome the shortcomings of such choke coils Gola devised an apparatus in the shape of a large shell, consisting of a choke coil and a number of large cast-iron diaphragms and shells connected in series by means of small copper conductors, the whole being placed in series on the line to perform the functions of a choke coil, and also to introduce an abrupt and great change in the section, material, and shape of the line conductors leading to the station apparatus. The device is illustrated in Fig. 1. In proximity to the sharp-edged ends of the shell are located corresponding airgap, horn-shaped lightning dischargers which are connected, through a resistance to ground, either directly here or in series with ordinary lightning arresters, according to the requirements demanded by the line voltage. The functions of the supplementary lightning arresters is to assist the main air-gap in rupturing the arc after the lightning discharge has taken place. It is claimed that while this device will allow the main line current to pass undisturbed, it will so obstruct the passage of lightning or static discharge currents as to cause them to be reflected at this point and pass to ground via the dischargers previously mentioned. This obstruction is claimed to be due to several effects of discontinuity of the circuit, in so far as the "homogeneous circuit of the line conductors of approximately constant section and of the same material (generally copper), always in a diamagnetic medium (air or insulating material), is suddenly interrupted by the introduction of several lengths of conductors of magnetic material of section and surface enormously greater, joined one to another by lengths of copper conductors again of small section, but placed in a magnetic medium, the whole with sudden changes of direction and section."

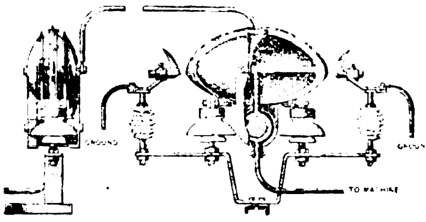

FIG. 1.

Gola, in the publication above referred to, makes several interesting comparisons between hydraulic and electrical laws, and by analogy attempts to explain the operation of the series arrester. The device has been used in many places in Italy for the last two or three years. In many cases it has proved to be most effective, while in other cases the results have been indifferent.

The "water resistance static discharger" of Friese and others is connected at each end of the line, one discharger between each conductor and ground, thereby forming a permanent continuous path to ground for a small fraction of the main line current. A general feeling prevails that this grounding will eliminate a great many troubles from lightning and surges on the line. Several ways of grounding the line are in use in Italy, but the one at the Morbegno station of the Valtellina three-phase railway may be considered as representative of the water resistance type of grounding device. The device, which is shown in Fig. 2, is mounted on an iron frame outside the station. It consists of grounded feed and discharge water pipes supplying the necessary water to three pairs of glass tubes, each pair being joined at the middle by a metallic union to which are brought the grounding connections from the line conductor; the grounding is made through the two water tubes in parallel. The current to ground in this system, operating at 20,000 volts (11,000 volts to ground) is 0.2 ampere from each line wire to ground. The superintendent of the station was hopeful of the success of the device.

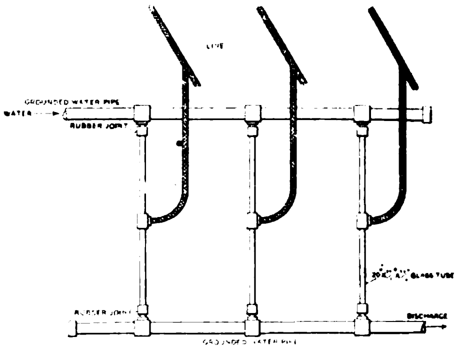

FIG. 2.

Water Resistance Static Discharger.

At the Paderno station of the Milan Edison Company a different arrangement of water resistance static discharger was being installed at the time of the writer's visit. It consisted of only three glass water tubes, but of greater diameter and length than those used in the Morbegno station. In this case it was also expected that the device would give satisfactory results.

Summarizing the observations made by the writer, the best practice of to-day for the protection of Italian transmission lines indicates that the plan illustrated in Fig. 3 should be adopted. The plan shows that:

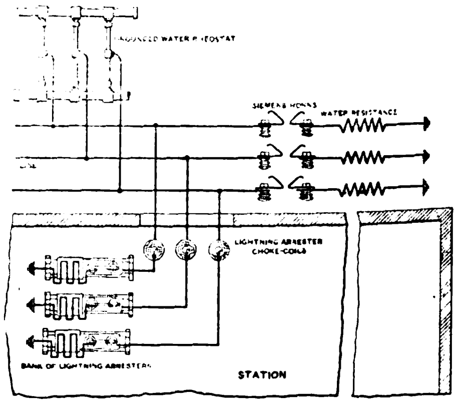

FIG. 3.—SCHEME OF STATION PROTECTION.

1. The terminals of the transmission lines should be extended in a direct line some distance away from their entrance

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[*] Paper presented at the 200th meeting of the American Institute of Electrical Engineers, New York, October 27, 1905.

into the station, and the ends should be equipped with Siemens' horn arresters grounded through water resistances.

2. On the line side of the branch entering the station a water resistance static discharger should be installed.

3. Choke coils and ordinary lightning arresters should be installed inside the station. Possibly choke coils of the series lightning arrester type should also be added.

4. Siemens horn arresters should be used on the poles along the line only after careful study of the installation. Series lightning arresters, with Siemens horn arresters, or ordinary lightning arresters may, however, be installed at particular points; as, for instance, where a line divides into branches, or at special points of a line installed in a mountainous country.

BELT COAL CONVEYORS.*

BY FRANCIS H. DAVIES.

In the design of power stations not favored with facilities that render such apparatus unnecessary, the question of coal conveying gear is always one of some moment; but when considered in connection with the mammoth power undertakings that are now springing up in all parts, this section of the auxiliary gear assumes an importance that gives it a position among the leading features.

The available ways and means of carrying coal from place to place are indeed legion, and in many instances, the ingenuity that has been brought to bear on the details of such apparatus is remarkable and interesting to follow; in this article, however, it is proposed to deal only with that class of machine known as the belt conveyor, for the reason that in Great Britain, at any rate, it is less understood and therefore, perhaps, less trusted than the familar "bucket," "worm," and "push-plate" types.

Unlike the above, it is difficult to fix any date for the inception of the belt conveyor; it would appear that as long as belting has been known and used, it has been adapted to a more or less crude manner to this purpose; consequently, dates of patent applications, the usual source serve only to mark epochs in the history of the subject, and cannot necessarily give any idea of when it entered the realm of things that be. Belt conveying has unquestionably been evolved, and in view of its recent adoption on a large scale in sundry power houses, both in Great Britain and America, and the improvements that are now enhancing its value to the engineering world, it may not be out of place to consider one or two of the old designs which were so notoriously bad as to have left their mark on the credit of the system, even to the present day. Broadly speaking, the disadvantage under which belt conveying suffers is high cost of upkeep due to the wear and tear of the belt itself, not to that of its pulleys or gearing in any way. On the other hand, broadly, its advantages are low first cost, greater reliability, having fewer parts to break down than any other apparatus, and the extremely small amount of power that it absorbs in operation. These two last features, particularly the latter, are of such obvious importance, and so pronounced, that they are generally accepted as a set off against the disadvantage of costly upkeep; and there are not wanting enthusiasts who go so far as to say that with well-designed and carefully tended plant the high repair bogey is nowadays an utter myth. Many, no doubt, may hold opposite opinions, but it is significant at least that two of the largest electrical power stations in the world, viz., that of the Underground Electric Railways of London at Chelsea, and the immense installation of the Interborough Rapid Transit Company of New York, have quite recently been fitted with belt coal conveying gear on a large scale, and it is unlikely in either case that such a course would have been taken except upon the very soundest of grounds.

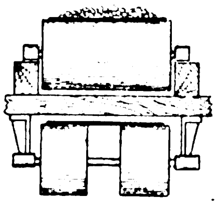

FIG. 1.

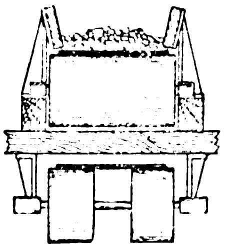

FIG. 2.

As is only natural, the earliest form of belt conveyor differed in no degree from an ordinary driving belt. It consisted of an endless belt of cotton duck generally faced with a thin sheet of india-rubber, running over flat pulleys as shown in Fig. 1, the return, or underneath side of the belt, being supported at intervals by suitable idle pulleys. Needless to say, this primitive arrangement was soon found to be unsatisfactory; it was only capable of carrying a disproportionately small amount of material, owing to the tendency of the latter to fall off the belt; it had to be kept very tight to prevent jarring at the pulleys and consequent shaking off of the load; and chiefly owing to this latter reason, the loss of power in the bearings was considerable. Further, it was only capable of slow speeds, and the amount of material delivered to the belt had to be most carefully and evenly regulated at all times. This system was found most suitable for conveying light stuff such as grain, as the resistance to motion created by the air tends to keep the load in a central position, with the result that with care speeds of 300 to 400 feet per minute may be attained. On the other hand, heavy material such as coal is not in any way affected by the air resistance, and consequently tends to spread itself out, necessitating much lower speeds and more care in working.

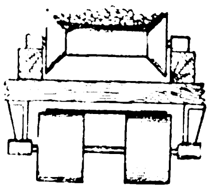

FIG. 3.

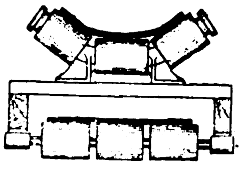

FIG. 4.

Perhaps the most obvious remedy for these faults lies in the arrangement shown in Fig. 2, in which it will be noted that planks of wood have been fixed on brackets at each side of the belt, with the object of keeping the material from falling over the edges. As far as this is concerned the skirting board system is satisfactory, but it introduces a very considerable fault that militates against the improvement which it effects.

It is found that the spaces between the underneath edges of the planks and the belt become full of the material that is being conveyed, and as to a certain extent this latter is wedged in and jammed, the result is bad cutting of the belt at the edges, which soon reduces it considerably in width.

This brings us to the stage of development which is the precursor of all modern systems, although, per se, still full of faults. The double conical pulleys over which the belt runs (Fig. 3) force the sides of the latter up, forming a continuous trough; but as there is a wide difference between the peripheral speeds of the inner and outer edges of the cones a large amount of slip occurs between them and the belt, which slip deteriorates the under surface almost as badly as the former system. The only feasible method of troughing a belt—and such is found to be absolutely necessary for conveying purposes—is to employ separate and distinct idle pulleys at the sides, as shown in Fig. 4, which is an end view of the well-known Robins system of belt conveying. By this arrangement there is no slip, and the wear and tear of all parts is reduced to a minimum. Occasionally the belt evinces a tendency to lift, in which case the spindles of the two side idlers are fitted with small rollers, placed at right angles, so as to bear on the edges of the belt and keep it in position (Fig. 5). A further refinement shown in this figure, and used at the place where the load is fed on, is that of skirting boards placed well clear of the edges of the belt, but so arranged as to protect them from the falling coal, which is thus caused to impinge on the heap in the center of the belt.

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*From the "Electrical Review," London.

This is the type of conveyor installed at the power house of the Interborough Rapid Transit Company of New York for elevating and carrying coal to the bunkers. In this particular case all the conveyors are from 300 to 500 tons per hour capacity and use a belt 30 inches wide. A very similar arrangement made by Mead, Morrison & Co., New York, is used at the Lot's Road power station of the Underground Electric Railways Company of London. The belt conveying coal to the crushers is 30 inches wide with a length of travel of 190 feet, and although its full working capacity is 240 tons per hour, a 10 hp. motor is ample to operate it. Two other similar conveyors are installed at Lot's Road for carrying the coal after crushing, etc., to the bunkers. Like the former they are horizontal, but only 24 inches wide, and as their length of travel is nearly 500 feet, they require more power, each being driven by a 20 hp. motor.

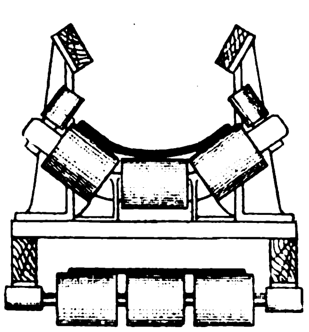


FIG. 5.

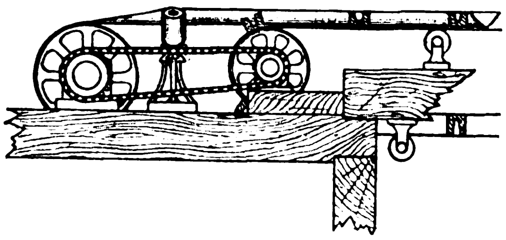


FIG. 6.

A recently introduced and ingenious method of belt conveying, is that known as the Ridgeway two-belt system illustrated in Figs. 6 and 7. Referring to these, it will be seen that running on separate and smaller pulleys there is an internal flat belt, fitted equidistantly with white wood blocks of an internally curved shape, which are riveted to it.

The driving pulley of this carrying belt is rotated through the agency of a compensating gear from the main power shaft of the conveyor, and the belt is provided on the top side with its own idle pulleys where necessary. The upper or conveying belt runs on flat pulleys at the driving and the driven ends, but at the points where it enters and leaves the blocks of the carrying belt, centering rolls are provided as shown, the duty of which is in the first case to give the upper belt the required curve before entering the blocks, and in the latter, to prevent its springing out of them as it approaches the end of its travel, and tends to go flat. On the return path, both carrying and conveying belts run on the same idle pulleys as shown, the blocks of the former bearing on the inside of the latter. The two belts run at exactly equal speed, although quite separate, and it is claimed that there is no rub between them, and that, with the exception of the power required to rotate the bottom idlers, the carrying belt does all the work, thus minimizing the wear and tear of the conveyor.

Reverting to the Robins type of conveyor, which may be taken as representative of usual practice, the width of the belt and the weight of the load determine the distance apart of the idler pulleys; but generally, those whose function it is to trough the belt are placed from 3 to 6 feet apart, while the lower or return set may be anything from 8 to 12 feet. Where circumstances are favorable, it has sometimes been possible to run the belt to a very great degree on simple flat pulleys, placing one of the centering type; say, at every fourth position to shift the material, which naturally spreads out when the belt is on the flat-back, to the center. The excuse for adopting such a method is, of course, cheapness; but it is doubtful if it is advisable excepting for the very lightest class of load conveyed at high speeds.

Of all the auxiliary gear attached to belt coal conveyors, perhaps that which provides for the loading of the belt is the most important. The chief cause of wear lies in the impact of the coal, and it follows, therefore, that this must be reduced to the lowest possible amount by feeding through a properly-shaped inclined shoot in the same direction as the travel of the belt, and as near as possible at the same speed. Vertical feeding is very harmful, and should never be resorted to.

Another important auxiliary detail is the tripper, which may be fixed or movable, automatic or otherwise, as occasion requires, and is used for unloading the belt at other places than at the end of its travel. It is shown diagrammatically in Fig. 8, and as will be seen, consists essentially of two pulleys, placed almost vertically, through which the belt takes an S-shaped path, the load leaving it at its first bend, and falling into a shoot arranged to deliver at the side. This tripper may be fixed in one position, or it may be movable, either by hand or through gearing by the belt itself, in order to distribute the coal uniformly in the bunkers. Also, by the agency of two parallel shoots it may be made automatic, the coal, after filling one bunker, and therefore the shoot, passing down the second one back to the portion of the belt that has been through the pulleys.

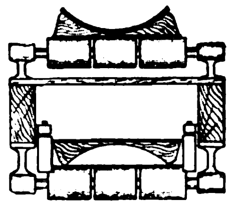


FIG. 7.

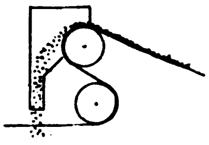


FIG. 8.

The use of belt conveyors on an incline, such as that shown in the diagram, is quite practicable under suitable conditions. A continuous supply of load is necessary if an incline approaches an angle of 30 degs., but with smaller angles a material such as coal will not slip appreciably even when fed intermittently. As previously stated, the wear of the belt has been the chief deterrent to the widespread use of these conveyors. It did not require much experience with them to show that while a rubber facing of the right kind withstood the wear very well, the canvas duck which forms the principal part of the belt deteriorates very rapidly where exposed to the cutting action of the load. For this reason conveyor belts are now made with a specially prepared rubber face of considerable thickness in the center, where most of the wear takes place. To allow it to assume a troughed shape easily, it is usual to decrease the thickness of the canvas backing in the middle, compensating for this by additional rubber. The thickness of the latter must depend upon the nature of the material the belt is destined to carry. Grain and such light stuff only require a thin layer, but coal being comparatively heavy and having many cutting edges calls for a thickness in the center of approximately a quarter of an inch of rubber, which may be thinned down to an eighth or a sixteenth of an inch at the edges where the wear is less.

As regards speeds and widths, the former may vary very largely according to conditions and individual ideas on the subject, and may be anything from 100 to 900 feet per minute, although this second figure is by no means usual or to be recommended, as it puts very hard work on both the pulleys and belt; 400 feet per minute is fair speed for level work, and for elevating this may be increased with advantage.

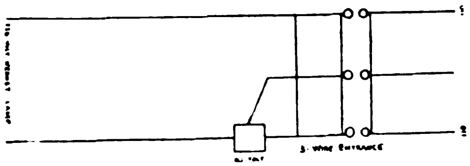
Widths range generally from 12 up to 36 inches, and a troughed belt of the latter size will carry nine times as much as one of the former, the capacity varying as the square of the width.

WRINKLES.[*]

EDITED BY H. C. ABELL.

Using a 110-Volt Meter on a 220-Volt Circuit.

The following is a rough sketch of a scheme that works all right when you want to meter a load on a 220-volt circuit, and have nothing but a 110-volt meter in stock. Run the line through the field of the meter in the usual manner, and the other side of the line goes to the lamp. Then for the shunt tap bring a wire from the center line, or the 110-volt side, and you are all right by using a constant of (2).



110-VOLT METER AND CONNECTIONS.

H. E. RYDER, Marlboro, Mass.

Trimming Municipal Arc Lamps.

We find a trimmer's cart drawn by a horse very economical, inasmuch as it requires only one man to trim our lamps, at the same time replacing all outer globes that may be broken and cleaning all inner globes. The cart is so arranged that it will hold 100 inner globes and 3 outer globes. Our lamps are General Electric, Form 3, 6.6-ampere, series-alternating, furnished by 50-light tub transformers. From April 1 to November 1 the lamps require new trimming every seven days, and from November 1 to April 1, the nights being longer, they require trimming every six days. Hence the trimmer has to make a complete round on all circuits in seven days during the summer-time, trimming about 90 lamps per day, and during the winter trimming about 95 lamps. The trimmer, having made his cart ready the evening before, makes his start at 7 o'clock in the morning, completing his day's trimming in five to seven hours, then returning to the electric station and washing all the inner globes removed from the lamps, and putting them on the dripping rack to dry; then he takes the globes that were washed the previous day and puts on bottom carbon holders and inserts bottom carbons. He then proceeds to arrange his cart ready for the next day's trimming.

R. A. HAMMACK,
Montgomery, Ala.

Electrical Assistants Wanted.

The United States Civil Service Commission announces an examination on November 22 at the Brooklyn Post Office to secure eligibles from which to make certification to fill about six vacancies in the position of electric assistant in the Signal Service at large, for a period not exceeding six months, at the rate of $75 per month during such employment, and vacancies as they may occur in any branch of the service requiring similar qualifications. Applicants should at once apply either to the United States Civil Service Commission at Washington, D.C., or to the secretary of the board of examiners at the New York Custom House for application, Form 1,312. No application will be accepted unless properly executed and filed with the Commission at Washington.

Electric Heating.

President Blood, of the National Electric Light Association, has appointed Mr. James I. Ayer to report on the progress of electric heating at the next convention of the association.

Proposals Invited.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until November 14 for furnishing Eastern Navy Yards with the following electrical material: Schedule 205, insulated iron wire, generating sets; schedule 206, electric cable and sockets; schedule 207, electric cable and insulators, copper wire. Blank proposals and specifications can be obtained at the Navy Pay Office in New York or upon application to the Bureau at Washington.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED OCT. 24, 1905.

Electric Railways and Appliances.

802,485. Railway Signal System. Charles W. Stiff and Claude L. McKesson, Colorado Springs, Col. Filed Dec. 1, 1904.

802,498. Retaining-Clip for Third-Rail Insulators. William Courtenay, New York City. Filed Dec. 6, 1904.

802,539. Trolley for Electric Cars. George F. Warburton, Denver, Col. Filed Aug. 6, 1904,

802,853-854. Electric Railway-Signal. Elwood W. McGuire, Richmond, Ind. Filed March 6 and 30. 1905.

802,749. Electric Signal for Railways. Frederick H. Gray, Leavenworth, Kan. Filed March 7, 1905.

Electric Lights and Appliances.

802,370. Illuminating Apparatus. Paul E. Collins, Boston, Mass., assignor, by direct and mesne assignments, to the Electric Novelty Machine Company, same place. Filed Aug. 29, 1904.

802,652. Dash Electric Headlight. Thomas Millen, New York City. Filed May 15, 1905.

Electrical Machinery and Apparatus.

802,369. Circuit-Controller or Electric Switch. John P. Coleman, Edgewood, Pa., assignor to the Union Switch & Signal Company, Swissvale, Pa. Filed April 1, 1904.

802,237. Insulator for Electric Wires. Clarance A. Humphrey, Elyria, O. Filed Feb. 15, 1904.

802,451-452. Electric Motor and Induction-Motor Device. Dugald C. Jackson, Chicago, Ill., assignor of one-half to Murray C. Beebe, Pittsburg, Pa. Filed March 8, 1900. Renewed Jan 26, 1905.

802,736. Electric Fuse. Frank B. Cook, Chicago, Ill. Filed July 9, 1904.

802,767. Current-Motor. Frederick B. Marvin, Paterson, N. J. Filed Dec. 1, 1904.

802,945 to 802,959. Electro-Magnetic Valve and Electro-Magnetic Valve Controlling System. Isaac G. Waterman, Santa Barbara, Cal. Original application filed June 25, 1903. Last application filed Feb. 8, 1904.

Telephones and Telephone Apparatus.

802,387, Telephone Cut-Out and Switch. Owen M. Galloway, Edward B. White and Adam D. Neptune, Mountayr, Ia. Filed Sept. 1, 1904.

802,513. Attachment for Telephone-Transmitters. Louis St. J. Johnson, Baltimore, Md. Filed June 18. 1902.

802,569. Telephone-Directory Holder. Louis St. J. Johnson, Baltimore. Md. Filed May 21. 1903.

802,644. Telephone Desk Set. William Kaisling, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed Nov. 23, 1903.

802,654. Telephone-Directory. Paul C. Murphy, Seattle, Wash. Filed Nov. 8, 1904.

802,671. Telephone-Exchange System. Harry G. Webster, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed Feb. 14, 1903.

Miscellaneous.

802,413. Electrical Apparatus. James E. Seeley, Los Angeles. Cal., assignor to the Synchronous Static Company, same place. Filed July 20, 1904.

802,417 to 802,432. Space Telegraphy. John S. Stone, Cambridge, Mass., assignor to Willam W. Swan, trustee, Boston, Mass. Original application filed Feb. 23. 1904. Renewed Aug. 17, 1905.

802,477. Thermostat. Frederick W. Robertshaw, Pittsburg, Pa. Filed Feb. 10, 1904.

802,480. Electric Interrupter or Vibrator. James E Seeley, Los Angeles. Cal., assignor to the Synchronous Static Company, same place. Filed Feb. 1, 1905.

802,573. Alarm System. John M. Latimer, Philadelphia, Pa, assignor, by mesne assignments, to the Consolidated Fire Alarm Company. Filed Sept. 11, 1902.

802,577. Conduit for Electric Wires. Robert W. Lyle, New York City. Filed Feb. 10, 1903.

802,619. System of Electrical Distribution. John H. Anderton, Boston, Mass., assignor to the Albert and J. M. Anderson Manufacturing Company, Portland, Me. Filed Feb. 28, 1905.

802,675. Electric Bell. Charles E. Avery, Jersey City, N. J., assignor to the Manhattan Electrical Supply Company. Filed March 16, 1904.

802,684. Heat-Coil. Frank B. Cook, Chicago, Ill. Filed April 8, 1905.

802,697. Circuit-Controlling Device. Harry T. Johnson, Jersey City, N. J. Filed April 2, 1904.

802,753. Electric Bell-Ringer. Ira W. Hall, Brownwood, Tex. Filed March 21, 1904.

802,896. Electric Lock. Nicholas W. Webb, New York City. Filed Nov. 1, 1904.

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[*] Paper presented before the National Electric Light Association at its 28th convention, held at Denver-Colorado Springs, Col., June 6-11 1905.

THE TELEPHONE WORLD.

Deal Closed for Telephone Properties.

A company headed by A. H. Bauer, of Bauer Brothers, St. Louis; H. C. Stifel, treasurer of the Althomer & Ralings Investment Company, St. Louis, and James S. Brailey, Jr., of Toledo, O., lately closed a deal for the controlling interest in the Indianapolis Telephone Company and the New Long Distance Telephone Company of Indiana. The consideration was not made public, but is said to involve about $710,000.

Speaking for the new company Mr. Brailey said. "We have closed a deal whereby we have become interested in both the Indianapolis and the New Long Distance Telephone Companies, and we have, at the same time, an understanding with certain local interests by which the management of the companies will be satisfactory to us."

Mr. Brailey and his associates declared emphatically that the Bell Telephone Company is in no way whatever cocnected with the deal. Mr. Brailey said they bought it with the understanding that the companies shall remain Independent, and that they shall be held largely by local men. He added that the management of the two companies will not be molested at this time. Mr. Brailey and his associates control the Toledo Home Telephone Company of Toledo; Mr. Stifel is largely interested in the Kinloch Independent Telephon Company of St, Louis and Mr. Bauer is a heavy stockholder in the Kansas City Home Telephone Company.

It is understood that they paid 55 cents on the dollar for stock in the New Long Distance Company. A few days ago, it is said, they deposited $75,000 with the Union Trust Company as a guarantee of good faith. The Trust Company bought up a lot of the stock for the new owners. It is understood that the largest block of stock in the New Long Distance Company was held by the estate of the late S. P. Sheerin, who was a moving spirit in both organizations. Louis Holloweg, of Indianapolis, is said to have controlled the Indianapolis company.

Among the Toledo people interested with Mr. Brailey in the deal are Ashbrooke & Co., Secor & Bell and Clarence Brown.

The New York Board of Estimate and Apportionment, at its meeting on Friday, called up the application of the Atlantic Telephone Company, which proposes to erect and establish a system with a view to giving a telephonic service in New York for 5 cents a call. The application was held over for a fortnight for further reports concerning the rights of other concerns.

The Denmark, Me., Telephone Company, capitalized at $10,000, has the following officers: President, E. L. Head; treasurer, C. L. Wentworth; clerk, M. H. Wentworth, all of Denmark.

The Knox County Home Telephone Company of Vincennes, Ind., will issue $125,000 preferred stock. I. E. Gardner, secretary.

The Nebraska Telephone Company is preparing to rebuild its lines in Central City. Between $10.000 and $15,000 will be expended.

The Wisconsin Telephone Company may retire from Kenosha within a short time, and leave the field to an Independent company. Negotiations are now pending between the officials of the Wisconsin company and those of the Citizens' Company of Kenosha for a consolidation of the two plants. The price of the combined plants is said to be $200,000, and it is thought that the new company will be formed shortly. The deal will eliminate telephone competition in Kenosha and will give the holding company a business of more than 1,800 subscribers. It is understood that the company will continue the long distance service by use of the Wisconsin company's wires.

G. R. Fuller, general manager of the Rochester, N. Y., Telephone Company, is devoting a portion of his time to Syracuse, looking after the installation of the new telephone system there. "As soon as the Syracuse system is ready to be operated," said Mr. Fuller, "Utica, Syracuse and Rochester will be connected by toll lines of sufficient capacity to care for all the business we can handle. We have fine service between Utica and Albany. The Independent Telephone Securities Company does not control any line east of Little Falls, but it has satisfactory arrangements with other companies whose lines extend to Albany."

Systematic thefts for several years of copper wire and other supplies, amounting to thousands of dollars, from the Newark, N. J., branch of the New York & New Jersey Telephone Company were disclosed last Thursday by the arrest of a junk dealer, in whose possession several hundred dollars' worth of the stolen goods were found.

The Converse, Ind., Telephone Company, which for the past five years has been a sublicensee of the Central Union Telephone Company, has severed its connection with the Bell interests and now connects only with the Independent system.

Work on the telephone conduit system, for which the East Tennessee Telephone Company was granted a franchise in Chattanooga several months ago, will begin at on early day. Captain A. G. Sharp is superintendent of the company,

The Independent interests propose to enter Greene County, Pa., starting at Waynesburg, in competition with the South Penn Telephone Company, which has lately allied itself with the Bell interests as a sub licensee. It is said that company will pay $2 a year rental for each Bell instrument.

The Northern Pacific Railway Company is constructing a long distance telephone line from Fargo, N. D., to St. Paul by way of Brainerd, Minn.

The New England Telephone Company has started the foundations for a new $20,000 office and exchange building at Burlington, Vt.

The Granville, N. Y., Telephone Company has increased its capital stock from $50,000 to $250,000.

The Northwestern Telephone Company has applied for a franchise in North Branch, Minn.

The fourth telephone company desiring a general franchise from Milwaukee, Wis., to establish an Independent exchange, made its appearance lately at the meeting of the common council, and it is expected that a fifth concern, which is at present being organized in St. Louis, will present its ordinance at the next session. The latest aspirant for a franchise has been incorporated under the name of Cream City Telephone & Telegraph Company, and as far as favorable conditions to the city are concerned, it is believed to have outbid all the former applicants. Back of the enterprise, it is said, is a syndicate of American capitalists, headed by W. D. Shroud, of St. Louis, which has just completed a new exchange in the city of Havana, Cuba, in which enterprise it had invested not less than $1,500,000. The local attorneys representing it in Milwaukee, are Wliam Kershaw and Walter Schinz.

The Marathon-Killawog, N. Y., Telephone Company has placed an order with the Century Telephone Construction Company of Buffalo for a switchboard for its exchange in Marathon, and expects to install 300 telephones in southern Cortland and northern Broome Counties. This company will have direct connection with the Inter-Ocean Telephone Company at Cortland.

The Palermo, Me., Telephone Company has been formed to construct and operate telephone lines from Palermo to China, Albion, Somerville, Hibert's, Gore and Liberty. The officers are: President, Silas E. Bowler; treasurer, W. W. Turner, both of Palermo.

The Buffalo, N. Y., aldermanic street committee has resolved to report in favor of the petition of the Frontier Telephone Company to erect and maintain at specified points street 'phones to be affixed to existing lamp posts with underground lateral connections.

Work on installing the Independent telephone system, known as the Home Automatic Telephone Company, for which Herman & Schatzman, of St. Louis, are handling the securities, was lately begun in Quincy, Ill. The plant will cost $500,000. R. S. Spencer, Charles Sutter and J. H. Murphy, all of St. Louis, are among the principal bondholders.

A recently organized concern, known as the Erie Wyoming Telephone Company of Sardinia, N. Y., is capitalized at $10,000. The directors are R. R. Allen, A. W. Phelps and H. B. Freeman.

Representatives of the Long Distance Telephone & Telegraph Company have been in the section of Lynnville, Tenn., securing rights of way and making general investigations in regard to locating an exchange in that part of the county.

The New York & New Jersey Telephone Company has increased its capital stock from $15,000,000 to $50,000,000. The amount of stock so far issued is $13,770,100.

The Cornwall Telephone Company of Cornwall, N. Y., capitalized at $5,000, has been organized with the following directers: W. B. Goodwin, Learned Hand and G. Morrell.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Alger, O.—This village will vote November 7 on issuing bonds to the amount of $3,500 for the purpose of securing electric lights.

Argenta, Ark.—This city will install an electric light plant and waterworks at an estimated cost of $65,000, and desires to engage a first-class mechanical engineer. C. J. Humphreys is secretary and collector of the board and W. C. Faucette, mayor.

Arlington. O.—The saw mill and electric light plant of Adam Beach in this place, which were recently destroyed by fire, will be rebuilt at once.

Auburn, Neb.—The city council has entered into a contract with the Auburn Mutual Lighting & Power Company to light the streets, lanes and alleys of the city with electricity for a period of five years.

Bay Spring, Miss.—The Bay Spring Lumber Company has been reorganized with a capital stock of $100,000, and will enlarge its plant and build an electric light plant to furnish the town with lights. The incorporators are W. B. Rogers, L. L. Denson, John Miller and others.

Birdsboro, Pa.—Plans are being made for an electric light plant here. It will be erected for the purpose of furnishing the residents of the village with better lighting facilities.

Bishopville, S. C.—The Bishopville Light & Power Company has been incorporated with a capital stock of $17,500 by A. C. Baskins, George M. Stuckey and R. W. McLendon.

Burlington, Vt.—The board of aldermen has passed a resolution appropriating $5,000 for the extension of the municipal electric light system.

Dana, Ind.—Work has been begun on the new electric light plant. The town is putting in the plant, and is buying nothing but the best of equipment.

Decorah, Ia.—W. H. Burtis has been granted an electric light franchise.

Far Rockaway, N. Y.—The Queens Borough Gas & Electric Company of this place will install a Curtis steam turbine and a generator, which will double the capacity of the generating power. The company found it necessary to make this improvement because of the extension of its gas mains and electric lines to the town of Hempstead.

Geary, Okla.—The Geary Electric Light & Power Company has been incorporated with a capital stock of $5,000 by J. J. Paige, Edward Ruggles, J. S. Moffitt and others.

Geneva, Ind.—W. R. Thurston, of Bern, accompanied by Messrs. Olds and Hartmann, of Ft. Wayne, were lately here looking after the electric lighting franchise which was granted about two months ago. Messrs. Olds and Hartmann take $5,000 of the stock, leaving a like amount to be subscribed for by the local capitalists.

Gravette, Ark.—G. W. Dunbar, of this place, who claims to be backed by Kansas city men, has made a proposition to the city council for an electric light plant and waterworks system.

L'Anse, Mich.—The $10,000 bonds issued by the village for the erection of a municipal electric lighting plant have been purchased by the Houghton National Bank. The council expects to have the plant in operation by December 1.

Lehigh, I. T.—The city council has granted a franchise for electric lights and power to the Consumers' Ice Company.

Lenoir, N. C.—The town commission has granted a franchise to E. C. Ivey for an electric light plant.

Malvern, Pa.—The Malvern Electric Light Company has been chartered with $5,000 capital stock.

Meredith, N. H.—The plant of the Meredith Electric Light Company has been purchased by the Laconia Electric Light Company, and the power station here will be discontinued. It is the intention of the new management to extend the wires from Lakeport to this place, a distance of about six miles, and the current for operating the Meredith light plant will be taken from the main power station. The work of setting poles and stringing wires will begin at once.

Morristown, Minn.—The citizens are agitating the establishment of an electric light plant.

Newport, Ky.—Harvey Myers, James H. Young and B. Bramiage have incorporated the Municipal Light, Power & Fuel Company with a capital stock of $200,000 to operate an electric light and power plant.

Ridgefield, Conn.—The Ridgefield Electric Light Company has purchased a site near the Ivy Hill crossing upon which the company will soon begin the erection of a power house and other buildings.

Rockvale, Col.—This town has granted a 25-year franchise to the Arkansas Valley Electric Light Company to put up poles and operate lights within the corporate limits of the town.

Roslyn, N. Y.—William K. Vanderbilt, Jr., heads a petition filed with the town board of North Hempstead asking that body to establish a lighting district at Lakeville and light the streets, avenues, public highways and places by electricity.

Roseville, Ill.—The Roseville electric light plant was lately sold to G. W. Rayburn.

Shawnee, Okla.—The Shawnee Union Electric Company will erect an electric light and power plant. The company is capitalized at $250,000.

Sheboygan, Wis.—Congressman Charles H. Weiss, of Sheboygan Falls, has purchased the entire $12,000 issue of bonds voted by the city of Princeton to acquire the local electric lighting plant. The bonds were bought for $11,900 and bear 4 per cent. interest.

Sparta, Ga.—The citizens have voted affirmatively on the bond issue for the construction of an electric light plant. R. W. Wood, mayor.

Westfield, N. Y.—The United States Canning Company is preparing to install its own electric light plant.

STREET RAILWAYS.

Ambler, Pa.—Work on the new trolley line from Center Square to this place will begin at once.

Ames, Ia.—This city will have an electric street car line next spring.

Baraboo, Wis.—The project of building an electric road from Kilbourn to Devil's Lake by way of this city has been revived. The Dells Company of Kilbourn is willing to supply most of the money for the proposed road.

Brazil, Ind.—David Morgan, secretary of the Indianapolis & Ohio Valley Traction Company, says that the company has accepted the franchise granted by the city.

Hughesville, Pa.—A new trolley line is to be built by Bloomington people from this city to Muncy. John G. Harman and E. F. Carpenter are at the head of the scheme.

London, Ont.—The talk of an electric line railway from Sarnia to this city has been renewed.

Schenectady, N. Y.—The Schenectady & Stamford Electric Line Company has been incorporated with C. T. Kromer as president.

Seymour, Ind —A meeting was lately held in this city by a company at the head of which is E. S. Russell, of Chicago, which proposes to build an interurban electric line from Columbus to French Lick.

Steubenville, O.—It is stated that the Wheeling Traction Company will shortly commence the work of building its new line from this city to Mingo.

Trenton, Ill.—Will O. Garvin, of the Farmers' Exchange Bank, is in correspondence with the Chicago capitalists who want to take up the matter of building an electric railway line between here and Chillicothe.

Wellsburg, W. Va.—A charter has been issued to the Wellsburg & Washington Electric Railway Company for the purpose of building an electric line from this city to Washington, Pa.

POWER PLANTS.

Atlanta, Ga.—A new electric light and power company will begin to do business in this city and various cities of Georgia during the early part of next year. All the plans have been completed. It is also declared that the investment capital that is involved amounts to more than $3,000,000 and that a number of prominent capitalists are interested in the proposition.

Birmingham, Ala.—The Coosa River Power Company, at the head of which, it is reported, will be Regert Zell, of this city, will soon be organized here. The amount of capital stock is not known. The object of the company will be the development of water power at Lock 3 on the Coosa River, and its transmission to Anniston by electricity.

Cadillac, Mich.—A petition from the Manistee River Power Company to be allowed to dam the river for power will be discussed by a special meeting of the Wexford supervisors on November 15. The plant will be modern in every detail and develop 3,000 hp. William Douglas, a Manistee millionaire lumberman, is president.

Rockville, Conn.—A power plant is to be erected for the Springville Manufacturing Company to cost $12,000.

Winnipeg, Man.—The Great Falls Power Company is to proceed at once with the development of 50,000 electrical horse power for transmission to this city. The flotation of the bonds of the company has been undertaken by H. M. Byllesley, of Chicago, who is backed by a group of 10 well known American capitalists. The bond issue is $6,000,000, all of which has been guaranteed.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 16⅜@16⅝c.; Lake 16⅜@16⅝c.; casting, 16⅛@16⅜c.

Reports that the Chicago Telephone Company will increase its dividend rate are denied by the officers.

The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent. on its preferred stock, payable November 15 to holders of record November 4.

The Texarkana (Ark.) Electric Street Railway, owned and operated by the Texarkana Light & Traction Company, has gone into the hands of Col. E. J. Spencer, of St. Louis, as receiver.

New York Metropolitan Street Railway shares have declined nearly 10 points within the past week without important rallies. It is said that the traders known as the Tammany crowd are heavily long of Metropolitan.

Shareholders of the San Francisco, Oakland and San Jose Electric Railway Company will meet on December 21 to vote on creating an issue of $1,500,000 second mortgage bonds, to provide for extensions and new rolling stock.

The preferred stock of the Western Telephone Company (Bell) has recently sold down to 91, against a high price of 104 last February. The common has declined from 22½ to 14. There is $16,000,000 of each issue outstanding.

The income bondholders' committee of the United Railways Company of Baltimore met on Friday last but failed to arrive at any definite conclusion looking to the refinancing of the road. The committee has now $5,000,000 of the income bonds in its control, out of a total issue of $14,000,000.

The right of stockholders to subscribe to the new stock of the New York and New Jersey Telephone Company will expire on November 30. Payments to be made as follows: 25 per cent. December 1, 1905; 25 per cent. April 1, 1906; 25 per cent. July 1, 1906, and 25 per cent. October 1, 1906.

Stone & Webster of Boston have bought the Nooksack power plant from the Bellingham Bay Improvement Company of Bellingham, Wash., and also the lighting franchises of the company. Plans for the plant provide for an ultimate development of a total from 12,000 to 15,000 horse power at a cost of approximately $1,000,000.

The United States Independent Telephone Company, which was recently organized to conduct a general telephone business throughout the United States, contemplates the immediate erection of a $6,000,000 telephone plant in St. Louis and the enlargement of the present apparatus manufacturing establishments in Rochester.

A representative of the Allis-Chalmers Company, when asked whether there was any truth in the report that the General Electric Company was buying stock of the former corporation and would secure representation on the board, replied: "It certainly looks like it. They will get representation on the board if they have sufficient stock to justify their admittance."

Denison, Prior & Co., of Cleveland and Boston, and Thomas Nevins & Sons, of New York, are offering for subscription $2,500,000, the unsold portion of the $5,000,000 underwriting of the Missouri Valley Electric Railway, which has been organized under the laws of Missouri for the purpose of constructing a high speed electric railway on private right of way from Kansas City, Mo., to St. Joseph, Mo.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. **Name.**	**Closing price Oct. 30**
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	211⅛
Manhattan Elevated Railway	165⅛
Metropolitan Street Railway	119
Metropolitan Securities	78¼
Ninth Avenue	197
Third Avenue	124¾
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	74½
Brooklyn City Railway	239
New Orleans Railway	88
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81¾
Philadelphia Traction	100⅛
Union Traction	62¾
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	13
do. do. do. pref	56
West End Street, com	99⅛
do. do. do pref	114½
Chicago.	
City Railway	192
North Chicago	83
Union Traction, com	10⅛
do. do. pref.	42½
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
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Allis-Chalmers, com	19¼
do. pref.	59½
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do. do. pref.	70
Electric Vehicle, com	15⅛
do. do. pref.	22
Westinghouse, com	168¾
do. pref.	197
General Electric	185
Boston.	
Edison Electric Illuminating	248
General Electric	185
Westinghouse Electric & Mfg., com	85⅛
do. do. do. pref.	100
Chicago.	
Chicago Edison	165
National Carbon, com	62¼
do. do. pref.	116
Philadelphia.	
Electric Company of America	11⅛
Electric Storage Battery, com	83
do. do. do. pref.	83
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	137
Western Telephone Company	13
New England Telephone Company	138
New York.	
American Telegraph & Cable Company	93
Commercial Cable Company	210⅛
Mexican Telephone Company	1
New York & New Jersey Telephone Company	179¾
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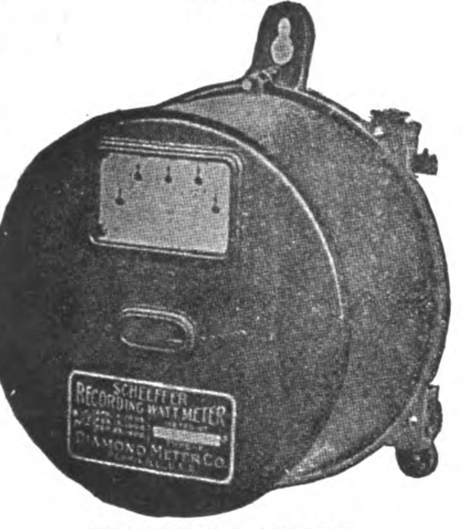
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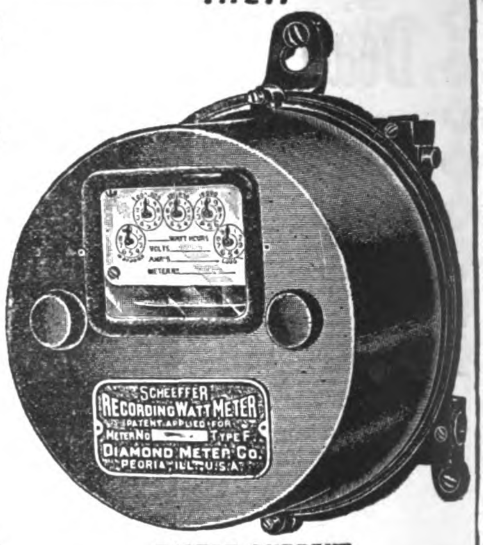
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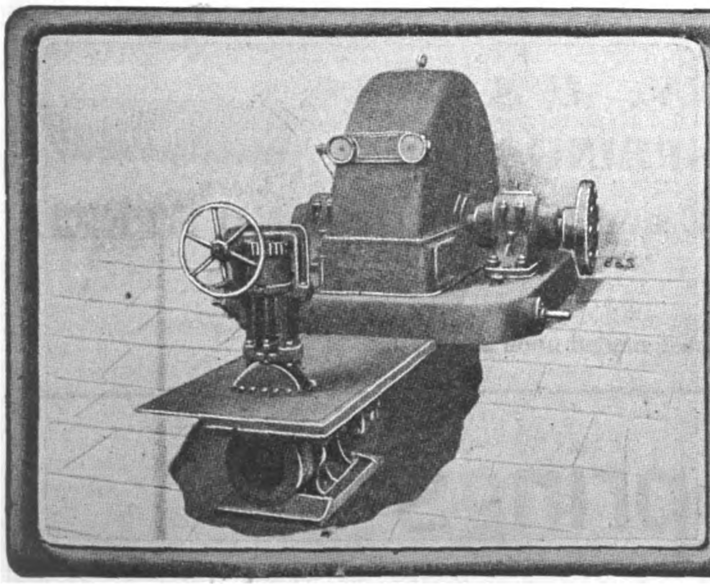

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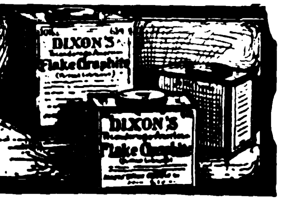
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ELECTRICITY.

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EDITORIAL NOTES.

Factory Power From Rivers.

Rivers represent revenue to that particular class of shrewd operators who see in a broad, smooth inland stream the possibilities we are accustomed to finding only in cataracts or mountain falls. They represent revenue not only to their exploiters, but to the manufacturing interests requiring more and cheaper power to expand to their true dimensions.

The largest enterprise of its kind yet undertaken in the United States will be begun about 12 miles from Chattanooga on the Tennessee River—representing a $3,000,000 investment in real estate, machinery and civil engineering construction. The direct beneficiary will be Chattanooga, within the confines of which city now exist 400 factories, employing thousands of hands and using thousands of horse power. The Tennessee River is 1,200 feet wide at the point where a dam is to be built. The backers of the scheme are New Yorkers, but the originators are well-known city residents, who gain their special engineering information from a New York expert employed as consulting engineer.

Interference with the free navigation of the river has been avoided by means of a lock extending to within three miles of the city. This is a great advantage commercially, and was the means of gaining the consent of the Federal authorities to the construction of the dam across it. The direct improvement of Chattanooga's waterway was admitted in Congress as being the sequel to this remarkable scheme, and aided in securing government consent.

A review of the circumstances shows factories for the manufacture of wooden, iron and cotton goods, which, it is firmly believed, will be doubled in number by the introduction of a new power supply. Fourteen electrical generators of 4,000 hp. apiece, a total of 56,000, will represent the amount on tap. This energy is obtained through the 35-foot drop the river takes about 21 miles beyond Chattanooga. Factory space along the river bank is now at a premium, and the demand for new sites is greater than the supply in that neigborhood. The city population has increased 10,000 with constant emigration from neigboring towns. The project now just started has caused a healthy boom, the results of which will be an industrial activity giving rise to a great increase in the number of workers, in the individual wealth and the general prosperity. The revenue derived from this power, on the basis of $50 a year per horse power—a very low estimate—will be at least $3,000,000 to the company. With the advantages due to better water facilities and the new power supply, Chattanooga may double her population before many months have passed. It will certainly double its wealth under these new and stimulating influences. Electricity is proving itself the savior of many inland towns.

* * *

The Induction Motor.

The various sections of the English Institution of Electrical Engineers are just opening their winter sessions. The section at Leeds commenced its proceedings on Wednesday, October 25, with the consideration of a paper by Mr. T. Harding Churton on "Alternate Current Induction Motors." He compared the Performance and Characteristics of motors of the induction type when provided with short-circuit, and with wound rotors, respectively; the performances of such motors on single-phase and polyphase circuits, and he also indicated, by comparisons, the extent to which the working of such motors is affected by the frequency of alternations. A particular size of machine with short-circuit and with round rotor, for single-phase and for polyphase working, and on circuits of various periodicities, was used as an example, and the results put forward in the course of the paper were obtained from actual tests on a number of machines of the same size. In each case the windings were appropriate to the circuit upon which the motor was to operate.

Curves taken from tests made upon two motors, one having a short-circuit rotor and the other a round rotor, but which were in other respects identical, showed that both the efficiency and power factor were higher with the short-circuit rotor machine. Both machines were 5 B.H.P.; speed about 1,420 revolutions, running on a single phase, 200 volt, 50 cycle circuit. The starting torque obtained with the short-circuit rotor machine was .45 full load torque with 1.25 times full load current, while the wound rotor machine gave .75 full load torque with full load current. The slip was somewhat greater with the wound rotor, but the latter would pull out of step rather sooner than the short-circuit rotor. The difference between the results obtained with the short circuit and wound rotors on polyphase working was practically the same as that on single phase, though with the polyphase system the results themselves were much better.

For the purpose of speed regulation the wound-rotor motor was the more satisfactory, though for some purposes, such as operating cranes, the short-circuit rotor with conductors of relatively high resistance, combined with graduated transformers for varying the voltage on the stator windings, was sometimes preferred to polyphase motors. A table was given showing the comparative performances with the two types of rotor with regard to starting torque and current on single and two-phase circuits of 50 cycles, 200 volts, clearly illustrating the superiority of the polyphase motor in this respect. By means of curves the efficiency and power factor were shown to be higher in the case of the polyphase motor, and the slip greater in the single-phase motor. The starting torque of the single-phase motor may be somewhat improved in several ways which involve lower efficiency on load. Here, as in most other engineering problems, "the question as to how far the running efficiency shall be sacrificed to improved starting performance is a matter of compromise." Mr. Churton held that though the single-phase could not upon equal terms compete with the polyphase motor, it was, nevertheless, in its better forms, an excellent machine.

* * *

Wireless Work of the Signal Corps.

An interesting report, particularly to electricians, has just been made by Gen. A. W. Greely, chief signal officer of the army. He regards as very praiseworthy the professional skill and exceptional ability of Capt. Leonard D. Wildman, who has charge of the wireless section of the Alaskan telegraph system, which he says, "is the only long wireless system in the world that is regularly operated as a part of a regular telegraph system, handling commercial business." This line has handled more than a million words in the year across the 107 miles stretch between Fort St. Michael and Safety. As many as 2,000 words an hour have been transmitted at times without error or repetition.

He states that the wireless work is done with an alternate current of 500 volts, generated by a 6 hp. gasoline engine. The De Forest receiver, modified by Signal Corps inventions, is used.

Gen. Greely regards the entire Alaskan system, aggregating 4,000 miles of cable land and wireless telegraph lines, as not only of the greatest military importance from a strategic standpoint, but of almost incalculable value commercially. Its use has already resulted in great benefit to the business interests of Alaska. During the year, 134,630 messages were handled, both Government and commercial. For the latter $78,000 was collected in tariffs.

Speaking of the general efficiency of the corps, Gen. Greely says: "At an hour's notice the Signal Corps can furnish field trains capable of installing and operating lines of communication to the extent of 1,000 miles. Special attention has been paid to the rapid development of lines of information as illustrated in the military manœuvres of Europe, during the South African contest and the Russian-Japanese war."

A special meeting of the stockholders of the General Electric Company has been called in Schenectady, N. Y., on December 5 for the purpose of voting upon a proposition to increase the capital stock of the company by $11,674,500, consisting of 116,745 shares of the par value of $100. This will increase the capital stock from the present amount, $48,325,500, to $60,000,000, all par value of shares $100. For the purpose of the meeting transfer books will close on November 11 and will remain closed until December 6.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

A cable dispatch from Geneva, Switzerland, says that an army of Italian workmen has been brought to that city to begin the construction of the new electric line which is to take tourists nearly to the top of Mt. Blanc.

On two test votes in the Chicago City Council Mayor Dunne and immediate municipal ownership were defeated by a vote of more than two to 1. He could muster only 21 votes for his proposition, as against 27 for it two weeks ago, a loss of 6 votes. One of the votes was 45 to 21 and the other 43 to 21.

The submarine signaling system, frequently referred to in the columns of ELECTRICITY, will shortly be installed on all ships of the Cunard Line.

Deaf mutes have demonstrated that there is one kind of skilled work in which they far excel the ordinary artisan. A Chicago telephone factory, after a series of experiments, found that to the making of the delicate mechanism of the modern telephone the deaf mute, by reason of the manual development incident to constant use of the sign language, is peculiarly adapted. One hundred and fifty deaf mutes are now employed in the factory at standard wages.

It has been known for some time that experiments in electric traction were to be carried out on the Vienna railway system, at present worked by steam. According to the "Elektrotechnischer Anzeiger" a continuous current 3-wire system is to be adopted with 3,000 volts between the outers, the latter being in form of overhead trolley wires, suspended by means of side poles and span wires. At present the line between Praterstern and Hauptzollamt (about 0.85 miles in length) is being electrically equipped, the Helenengasse sub-station for converting the three-phase 5,000-volt current from the municipal electricity works to continuous current is being built, while the 800 hp. experimental locomotives are already on hand. Each locomotive has four 200 hp. motors. The controllers permit of all four motors being connected in series across the outers, or in two groups of two motors each.

THE INSTITUTE'S SILVER TABLET.

A pleasant incident at the 200th meeting of the American Institute of Electrical Engineers, held in New York City October 27, was the exhibition to the 300 members in attendance of the silver tablet presented to the Institute by the Associazone Elettrotecnica Italiana, as a testimonial in recognition of the courtesies extended to the members of the Italian society on the occasion of their American tour in August and September, 1904.

Silver Tablet Presented to the American Institute of Electrical Engineers.

The tablet is an artistic silver casting, mounted on a marble slab, the design embodying medallion portraits of Volta and Franklin, and an inscription in Latin, of which the following is a literal translation:

"By this testimonial, the Italian colleagues place on record, for all time, their reception in gracious and generous hospitalty, by their American colleagues, during the months of August and September, in the year 1904; may it be of good augury.

"Rome, the 31st day of the month of December, in the year 1904."

This tablet will be placed in a prominent position in the Institute headquarters in the Union Engineering Building, now in process of construction.

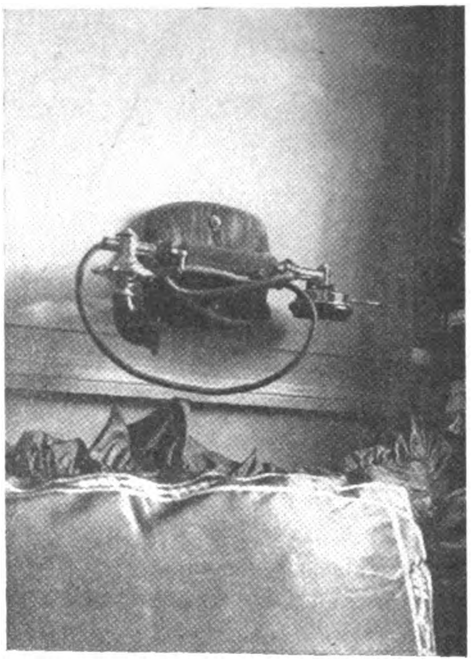
New Type of Street Car.

Montreal, Canada, has a new type of railway car. The passenger enters at the rear end and passes through a doorway, where the conductor, in a species of ticket office, collects the fare. It is stated that the company gathers in 25 per cent. more fares in this car than it did in the old type. This is one of those reforms that street railway companies find out for themselves.

ELECTRICAL FEATURES OF THE "AMERIKA."

BY IRVING THOMPSON.

Representing as it does the most advanced ideas in marine engineering, the new steamship "Amerika," of the Hamburg-American line is probably the most unique vessel afloat. In its interior arrangement it resembles a first-class hotel with its army of servants and exceptional appointments, not the least interesting and novel of which are passenger and freight elevators, gymnasium, restaurant and children's play-room. Of special interest is the extensive use of electricity, for never before were there so many devices common to shipboard which rely upon electric current for their power. The entire dynamo plant is capable of developing over 400 kw. The main plant consists of five dynamos, having an output of 750 amperes each at 100 volts. These are direct connected to high speed engines which take steam at 100 pounds pressure through reducing valves from the main boilers. These dynamos, together with the main switchboard, are located on the engine room floor, which is a considerable distance below the water line. For use in case of an emergency, such as the flooding of the engine room, an auxiliary equipment, consisting of a direct-connected unit having a capacity of 300 amperes, is placed on the Franklin deck, which is several feet above the high water line. The main switchboard is approximately 30 feet long and 7 feet high. Each dynamo has its own individual panels, upon which are mounted the necessary volt and ammeters. The board for the auxiliary installation is 4 feet 6 inches by 3 feet 6 inches. This controls the police lights in the gangways, masthead and side lights, and the illumination for the engine room and stoke holes.

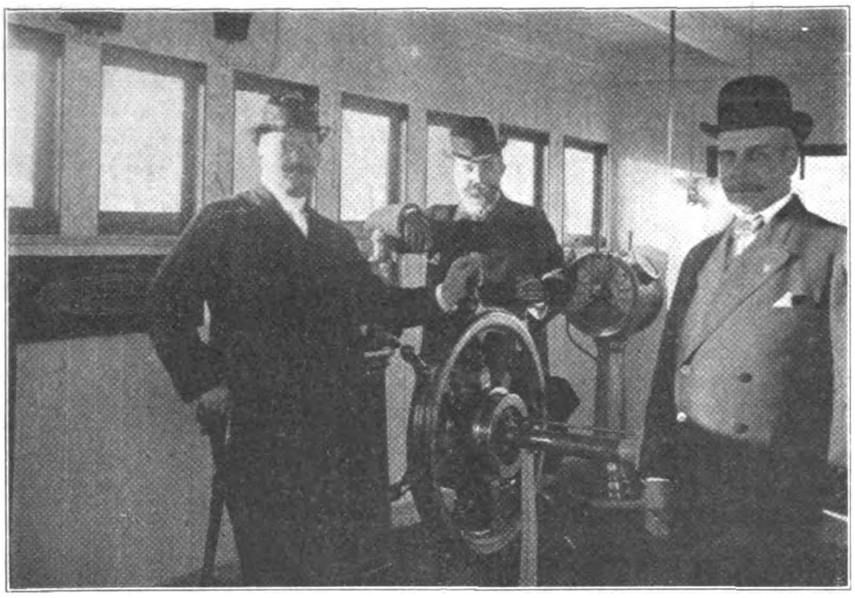


Hand Micro-Telephone in a Stateroom of the "Amerika."

For illuminating purposes there are upwards of 4,000 incandescent lights, varying in candle power from 10 to 32, including 16 and 24. There are 40 distributing boards which control the deck and cabin circuits.

One noticeable feature about the steamer is the entire absence of ventilating cowls upon the upper decks. Proper air circulation is secured through a system of forced draught, which extends throughout the vessel. For this purpose there are 19 direct motor driven Sirocco fans. These motors take from 25 to 81 amperes each. The air is drawn down through tubes from the upper deck and forced through pipes into every stateroom, cabin, saloon and passageway. In addition to the ventilating system there are two exhaust fans for removing foul air.

In the kitchen department there are two motor-driven dough mixers, six motor-driven knife cleaners, two motor-driven plate-washing machines, and motor-driven coffee-grinders and meat-choppers. In the gymnasium there are motor-driven exercising machines.



The Wheel House of the "Amerika."

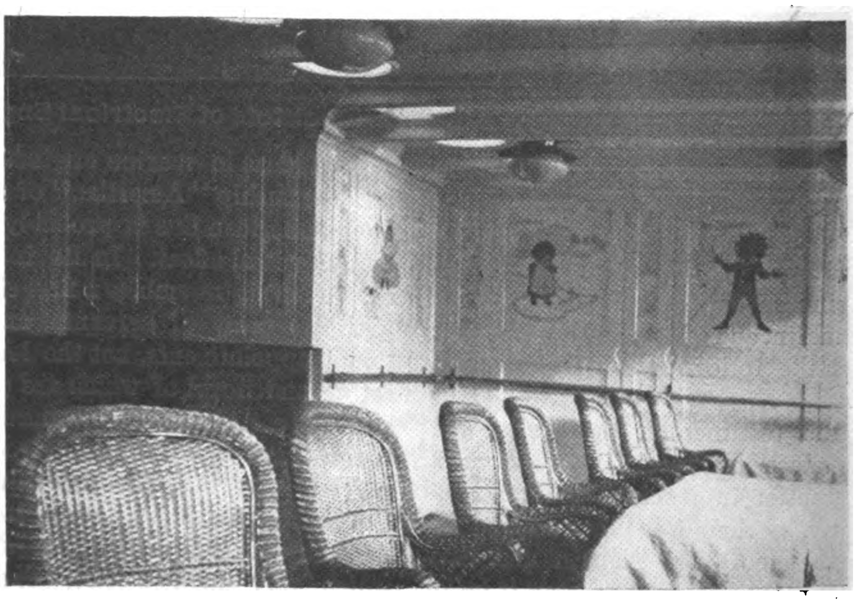
The elevators are operated by electricity as are also the two engines, revolution indicators and counters; for this purpose there are two dynamos, one connected to each propeller shaft, which operate indicators in the engineer's office and on the bridge. There is also a rudder position indicator, which shows the exact angle at which the rudder is placed.

The staterooms and cabins are heated by electric radiators which require a total of 750 amperes. Amongst other uses to which electricity is put is an electric bath, which requires 50 lights. For making cakes there are five electric griddle plates. Electric curling iron heaters are placed in all staterooms. An electric system of clocks controlled by a master clock extends throughout the vessel, as does also a fire alarm system. Electric bells are used for signaling purposes in connection with the water-tight doors. There are four separate telephone systems—one for stateroom service and one for pantry and steward's use, which employ the hand micro-telephones. One marine system which is equipped with water-tight instruments, and the Blake submarine telephone signal system. The switchboard for the stateroom system is located at the bureau of information. For the steward's use there are four annunciator boards with telephone attachment, besides the regular push-button call annunciators.

The water-tight marine instruments connect between the bridge, crow's-nest, fore and after decks, engine room and engineer's office. The submarine receiving instrument is located in the telephone house on the bridge, and connects with two receiving transmitters, located one on either side of the bow of the vessel below the water line.

In conclusion it may be of interest to note the following facts respecting this remarkable vessel. She measures in length over all 687 feet; breadth, 74 feet 6 inches, and depth, 53 feet. From the top of the bilge tanks located below the engine room floor to the apex of the engine-room skylight is a distance of 111 feet.

The engines are quadruple expansion of 8,500 hp. each. The coal consumption is approximately 260 tons every 24 hours. Her displacement is nearly 42,000 tons, which is greater than that of any other vessel afloat. In the cargo holds there is room for over 16,000 tons of merchandise. There are accommodations for 3,057 passengers, which are divided into four classes, there being an intermediate division between the second and steerage passengers.



Lighting Arrangement of Special Children's Cabin of the "Amerika."

An innovation in the nomenclature of the various decks is the departure from the usual nautical designations. Instead of main, upper, lower, orlop, etc., four of them are given the names of foremost Americans, and one is called the Kaiser. The four American-named decks are the Washington, Roosevelt, Cleveland and Franklin.

SOME EXPERIENCES WITH LIGHTNING PROTECTIVE APPARATUS.[*]

BY JULIAN C. SMITH.

This paper will deal with some experiences with lightning protective apparatus which the operating department of the Shawinigan Water & Power Company has had during the years 1903, 1904 and 1905.

The generating station at Shawinigan Falls has three generators each of 3,750 kw. capacity, 2,200-volt, 30-cycle, two-phase, and one generator of 6,600 kw. capacity, 2,200-volt, 30-cycle, two-phase. Each of these generators is direct-connected to a water-wheel operating under a head of 130 feet.

Referring now only to the long-distance lines, it is sufficient to note that the energy is delivered through a double set of bus-bars to the low-tension side of the step-up transformers. These transformers are T-connected for transforming from two-phase to three-phase. The ratio of voltage transformation is 2,200 : 50,000. The neutral point of these transformer banks is grounded, giving about

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[*] Paper presented at the 200th meeting of the American Institute of Electrical Engineers, New York, October 27, 1905.

29,000 volts between each wire and earth.

In 1903, only the No. 1 Montreal line was operating. This line connected the generating station at Shawinigan Falls, P. Q., with the Montreal terminal station, situated just outside the city of Montreal. The distance from the generating station to the terminal station is 85 miles. The transmission line consists of three 7-strand aluminum cables, each of 185,000 circular mils cross-sectional area, spaced 60 inches apart, and arranged in the form of an equilateral triangle with the apex upward. These cables are supported on 35-foot poles, with cross-arms 6 feet long fastened with through bolts. The top of every pole is bored to receive a pin. All pins are 18 inches long and were boiled in stearine.

The voltage at Shawinigan is normally about 50,000; at the Montreal terminal station it is 44,000.

In the spring of 1904, a sub-station was built in Joliette, distant about 45 miles from the generating station, and from this sub-station a branch line was built to the city of Sorel. This line is about 20 miles long and is operated at 12,500 volts. The only special point of interest is a submarine cable about 5,000 feet long, by means of which the line crosses the St. Lawrence River.

In the Montreal terminal station the voltage is reduced to 2,400 and supplied to a set of 30-cycle bus-bars. From these bus-bars the frequency-changers are operated. Each frequency-changer consists of a 30-cycle synchronous motor connected to a 60-cycle generator. There are at present installed in this station five of these motor generators, each of 1,000 kw. capacity and one of 5,000 kw. capacity. In addition to these machines there are two synchronous converters, each of 1,000 kw. capacity, operating street railway circuits. It is interesting to note that the whole load of the long-distance line consists of synchronous apparatus, and that by properly regulating the fields of this apparatus the power-factor can be kept at unity.

In the fall of 1904 the No. 2 Montreal line was completed. The No. 2 line is parallel to the No. 1 line for nearly the entire distance, and in most places is not more than 100 feet distant. The second line is similar to the first except for the size of the conductor and for the fact that a ground wire is strung along the line at the neutral point of the triangle. This ground wire is connected to the earth at each pole by a wire running down the pole.

When the No. 1 line was put into service the lightning apparatus installed was as follows: At each end of the line was a bank of Westinghouse lightning arresters of the low-equivalent type and a bank of static-interrupters. The number of gaps in these arresters was decided upon after a series of tests had been made to determine the lowest practical break-down voltage. These arresters were set to discharge at about 65,000 volts. In 1904 a bank of General Electric arresters was placed on the 50,000 volt line in the Joliette sub-station. This bank was also adjusted to discharge at about 65,000 volts. In 1904 three banks of horn-arresters were put on the No. 1 Montreal line. These arresters consist of bent copper rods. The horns were spaced 6.25 inches apart at the gap, this distance corresponding to a break-down voltage of 90,000 (see Fig. 1). In 1905, when the No. 2 line was equipped with lightning arresters, three banks of low-equivalent arresters were put in, one at each end and one at Joliette. In addition to these arresters three banks of the 1905 type of horn-arresters were put in. Some changes were made in the setting of these arresters as will be noted farther on.

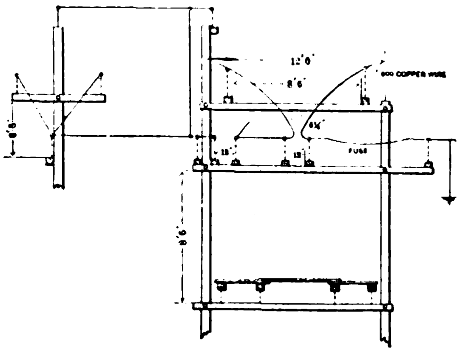


FIG. 1.
Horn Lightning Arrester, Joliette.

The Montreal lines run in a general northeasterly, southwesterly direction, parallel to the St. Lawrence River, and about 20 miles distant from it. The elevation of the power-house is about 200 feet above sea-level, that of the sub-station being nearly the same. Some 10 miles farther north and parallel to the transmission lines, the Laurentian Mountains bound the north side of the St. Lawrence Valley. In general, the country over which the lines pass is a flat farmland, but near the power-station the country is very rough.

The prevailing winds are westerly, and the general course of the electrical storms is parallel to the lines. The storm period extends from March to October. Nearly all the storms occur during the latter part of June, and in July, August and early in September. The storms are most severe during July and August. In the territory covered by the lines of the Shawinigan Company there occurs during each year about fifteen thunder storms. As these storms move along in an easterly direction and sometimes take days to cover the 100 miles, we have found that from June 25 to September 10, a storm is reported nearly every day from some part of the line. In general, however, there are not more than four or five severe storms during each year, and these storms are most severe in well defined localities. The discussion of our experiences with lightning will be simplified if these experiences during 1903, 1904 and 1905 are considered separately, year by year.

As stated above the only line in operation in 1903, was the No. 1 Montreal line. That line was protected by low-equivalent arresters at each end. During the summer of 1903, several disturbances occurred, which may be summarized as follows:

1. Poles splintered by heavy discharges.
2. In a few instances, insulators broken.
3. Flashes across the static-interrupter terminals.

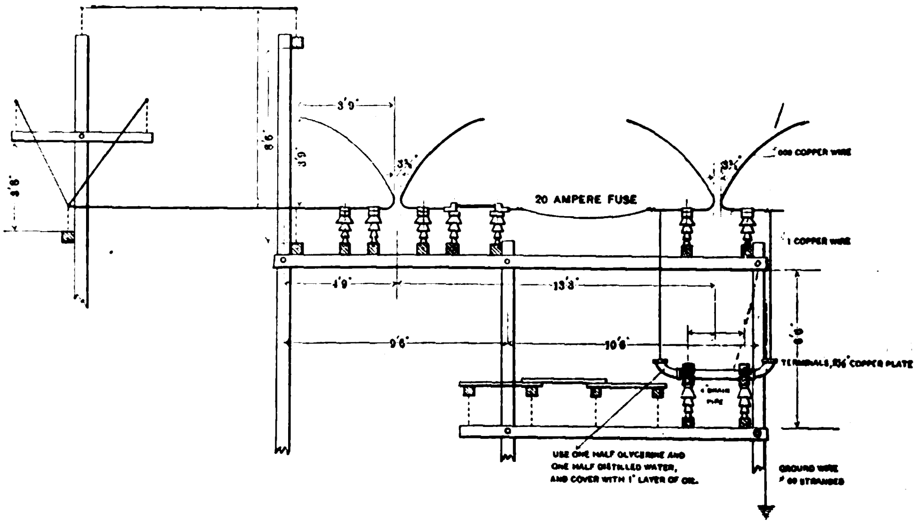

3'9"
8'6"
3'6"
3'8"
3¼"
3¼"
20 AMPERE FUSE
000 COPPER WIRE
1 COPPER WIRE
4'9"
13'3"
9'6"
10'6"
TERMINALS, 3/16" COPPER PLATE
4" DRAIN PIPE
USE ONE HALF GLYCERINE AND ONE HALF DISTILLED WATER, AND COVER WITH 1" LAYER OF OIL.
GROUND WIRE # 00 STRANDED

FIG. 2.
Horn Lightning Arrester and Resistance. Type 1905.

4. Arcs on the transformer terminals.

5. Arcs inside the transformer cases at the top between adjacent leads.

6. Damage to apparatus caused by 3, 4 and 5.

7. Interruption to service, due usually to excessive voltage-drop, causing synchronous apparatus to fall out of step.

1. On several occasions poles were splintered. In most cases two or three poles were torn to pieces; the adjacent poles on both sides were less damaged, the damage decreasing as the distance increased from the point of disturbance. One of the worst cases recorded by us shows that five poles were torn to pieces, while ten poles on each side were somewhat splintered. This disturbance extended over a distance represented by 25 poles, or about 2,500 feet. This case, however, is exceptional, usually not more than one pole is badly damaged and a few of the nearby poles slightly splintered.

2. In only one or two instances were insulators broken; in each instance it was the top insulator. In these cases the breakage seemed due to the flashing over and consequent heating, as the insulator was not in any case punctured. In no case was an insulator so badly damaged as to need immediate replacing.

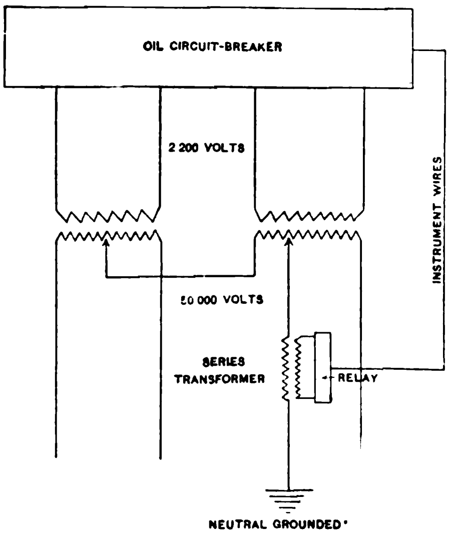


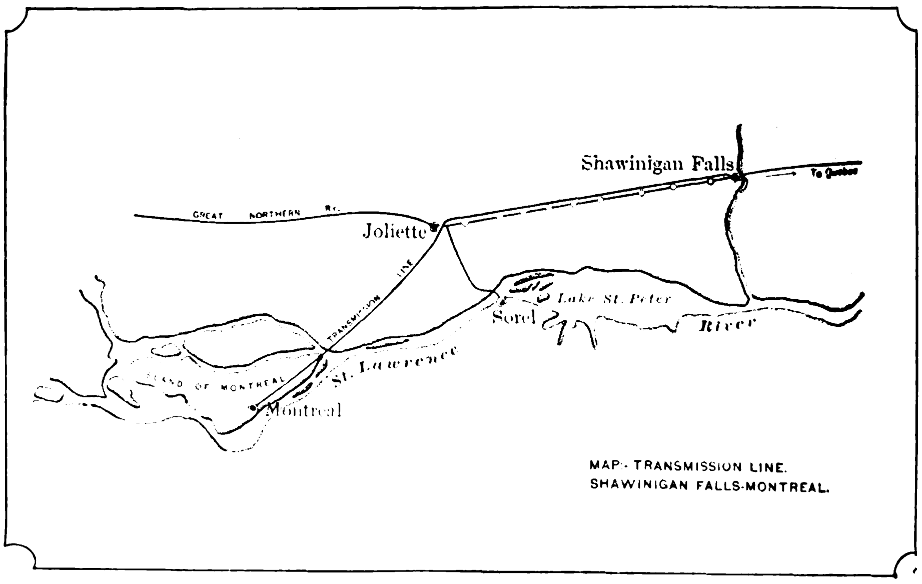
Fig. 3.—Transformer Connections.
Note—Neutral point grounded through a series transformer and relay. Current in ground-wire, trips oil circuit-breakers.

3. At the same time that the poles were splintered on the line, there would be evidences of excessive potential in the stations. The most frequent occurrence was an arcing over on the terminals of the static-interrupters. In some cases this flash would reach across to an adjacent static-interrupter and establish a short circuit between the lines. In most cases, however, it was simply a flashing from the ends of the terminal to the case, or between the incoming and outgoing wires of a single static-interrupter, thereby short circuiting the reactance coil.

4. The arcs on the transformer terminals were more rare, only occurring when the static-interrupters were put out of service by the flashing over mentioned above.

In view of the above disturbances and damage it was decided to put in a type of horn lightning-arrester affording a low resistance path to ground, to depend on a fuse for the interruption of the short circuit which would occur if the horns did not break the arc, and to set these horns so, that only the heavier discharges would break them down. The horns were consequently adjusted to discharge at about 90,000 volts.

At the end of 1903, it was determined that the arresters installed were sufficient to meet the conditions caused by ordinary storms. They protected the line from abnormal rises of potential due to switching or short circuits; but in those cases when the lightning-stroke damaged poles on the line the rise of potential was so high and took place so rapidly that the arresters could not carry enough current to keep the potential of the line to within safe limits. The horns installed were especially designed to meet only the conditions which were not met by the standard arresters.



MAP - TRANSMISSION LINE.
SHAWINIGAN FALLS-MONTREAL.

In 1904 there were more than the usual number of storms. On the following dates the horns discharged:

Date.	Shawinigan.	Joliette.	Montreal.
July 11..	3 horns.	1 horn.	None.
Aug. 5..	2 "	3 horns.	"
Sept. 20.	2 "	2 "	"

One or two storms did not cause any disturbance.

The storm of July 11 was central near the power-station, and one pole about five miles distant was splintered. The Joliette horns discharged about an hour before the discharges took place at Shawinigan.

On August 5, the storm was central at Joliette. Both the horn arresters and the standard arresters discharged violently, the horns at Shawinigan discharging at the same time. There was evidently a rise of potential in the Joliette station, as one of the glass windows through which the wire enters the building was cracked, due to the flashing over which must have occurred. At the same time that this disturbance occurred in the station, some 25 poles about five miles away were splintered, a few of them very badly. No disturbance other than the discharge of the arresters occurred in the other stations. The service was not interrupted, a rather severe blow being felt, lasting only about a second.

On September 20, the storm was central about midway between Shawinigan and Joliette. Fifteen poles were struck. No excessive potentials were noticed in the stations, nor was the service interrupted.

During 1905 the number of storms was less than usual, but there were two very violent storms, both near Shawinigan. Poles on the No. 1 line were damaged. At various times during the summer the horns of both lines discharged, but it is noteworthy that the horns of the two lines did not discharge at the same time; that is, the two lines only about 100 feet apart would not be equally affected by lightning discharges.

The horn arresters on the No. 2 line were designed to take less current than those on the No. 1, as a resistance consisting of a mixture of glycerine and water was put in the ground connection; in parallel with this resistance was a horn-gap. During the first storms it was noticed that the resistance had "an equivalent spark-gap", greater than the horn, although the resistance was about 10,000 ohms, and the gap about 3 inches. The resistance was greatly decreased early in the summer by pushing the terminals closer together and the gap was slightly increased. After this was done the lightning discharge went through the resistance.

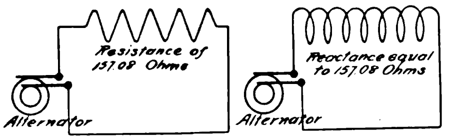
Another factor came into play in 1905. The two long-distance lines are operated in parallel on the low-tension sides at both ends. As stated previously, the neutral point of the transformer banks is grounded at Shawinigan. A series transformer was placed in the ground-wire leading from each bank of transformers, and an overload relay connected to this series transformer so that if any considerable amount of current flowed into the neutral the relay would open up the low-tension side of all of the transformers connected to that line. The operators in the Montreal terminal station were depended upon to separate the two lines in cases of trouble. By this means, a ground or heavy disturbance on one line would cut that line out of service. Our experience during the past year shows that this scheme works satisfactorily. To some extent, however, it masks the action of the lightning-arresters, as in case of heavy discharges over the horns the relay would cut off the line.

Summing up our experience with reference to the horns, I would say that we consider them a valuable addition to the standard equipment. Since the installation of the horn arresters, we have had no arcs in our station. No damage has been caused to our apparatus. No interruptions to our service have been caused directly by lightning. On the other hand, each time the horns discharged a more or less severe short circuit occurred, in no case, however, being severe enough to cause trouble or to cause our synchronous apparatus to fall out of step.

LIGHT, HEAT AND POWER PRINCIPLES.—VII.

BY NEWTON HARRISON, E. E.

Self-Induction and Resistance.—When the current is suddenly varied in a circuit the lines of force surrounding the circuit vary correspondingly and create within it self-induction. But this self-induction is able to produce an effect within the circuit equivalent to the presence of resistance, as far as the limitation of the flow of current is concerned with an alternating electromotive force. The name given to this effect has been variously styled spurious resistance, inductive resistance or reactance. It must be understood that the success of electric lighting and power distribution, as well as transmission, are dependent upon a proper consideration of the relationship existing between the self-induction, resistance and capacity of the circuits carrying alternating electrical energy. By this is meant, that the degree to which the angle of lag appears is a measure of the amount of useful power in the circuit. This inductive resistance arising in the circuit, through the variations in the current strength, is not an energy-wasting form of resistance. It simply suppresses the full manifestation of energy otherwise possible. The ohmic equivalent of it may be given by means of a simple calculation, $p \times L$, which takes into consideration the frequency with which the current alternates per second, and the self-induction. The exact values of these are given under the symbols of $p = 2 \times \pi \times f$ and $L =$ henries, in which $f =$ cycles per second, $\pi = 3.1416$, and L represents a definite quantity obtained by special calculation. Before L is calculated in detail, with respect to coils carrying a current, the value of reactance, as it is called, when caused by self-induction and frequency, will be shown in a specific case. The inductive reactance of a coil, for instance, in which a current passes alternating 100 times a second, and having a self-induction $L = .25$ henry, would be $2 \times \pi \times 100 \times .25 = 2 \times 3.1416 \times 100 \times .25 = 157.08$, representing the equivalent in ohms in the circuit. If the frequency were doubled the inductance reactance would be twice as much, or $2 \times 157.08 = 314.16$.



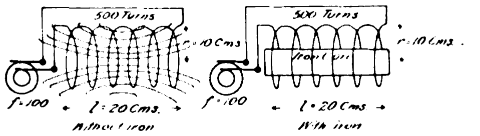
Resistance equivalent of inductive reactance.

TABLE BASED UPON THE INDUCTIVE REACTANCE $2\pi f L$.

Frequency.	Self-induction.	$2\pi f L$.	Ohms equivalent.
10	.1 henry	6.28 × 10×.1	6.28
20	.1 "	6.28 × 20×.1	12.56
30	.1 "	6.28 × 30×.1	18.84
40	1 "	6.28 × 40×.1	25.12
50	.1 "	6.28 × 50×.1	31.40
60	.1 "	6.28 × 60×.1	37.68
70	.1 "	6·28 × 70×·1	43·96
80	·1 "	6.28 × 80×.1	50.24
90	.1 "	6.28 × 90×.1	56.52
100	.1	6.28 × 100×.1	62.83

The above table shows the variations in reactance with systematic variations in the frequency. The ohmic equivalent of reactance, due to inductance, is thus shown to be increased if the frequency increases, and to decrease if the frequency decreases. The case above noted would be practically that of a coil of fixed self-induction, through which currents of an increasing frequency have passed.

Self-Induction of a Coil.—The calculation of the self-induction of a coil is simple enough to only require arithmetical treatment. The elements to be considered are those relating to the construction and core of any coil. When the coil has or has not iron in it as a core, the self-induction is less or greater in proportion to the permeability of the iron. The self-induction $L = 4\pi^2 r^2 n^2 \div l \times 10^9$ when the coil is not very thick and contains no iron. If there is an iron core, then $L = 4\pi^2 r^2 n^2 \mu \div l \times 10^9$, which is approximately true for the character of coils cited belonging to the class generally employed with fairly high frequencies on alternating current lines. In these two formulas, based upon the absolute system, $L =$ henries of inductance, $\pi = 3.1416$, $r =$ mean or average radius of coil in centimeters, $n =$ the number of turns of wire, and $l =$ length of coil in centimeters. The μ varies with the number of lines of force in the core or its degree of magnetization. In applying the formula the following case may be considered: A coil 20 centimeters long, whose average radius equals 10 centimeters, the number or turns being 500. According to the formula $L = 4\,(3.1416)^2 \times 10^2 \times 500^2 \div 20 \times 10^9 = 4 \times 3.1416 \times 3.1416 \times 100 \times 250{,}000 \div 20 \times 10^9 = 3{,}948 \times 25 \times 10^4 \div 2 \times 10^{10}$ equals, after canceling through, the total of .04935 or, what is called on the basis of $\frac{1}{1000}$ of a henry, being called a millihenry, 50 millihenries. These results may be developed with respect to a coil having iron in it, as mentioned with reference to the permeability μ. If in the case just noted the permeability is given as 500, then the result obtained, .04935 henries, will be multiplied by 500 and become $500 \times .04935 = 24.675$ henries. A table built up on this basis, showing the difference between a coil, with and without iron as a core, is given as follows:



Comparison of inductance of coil with and without iron.

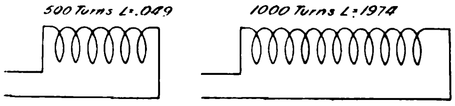
TABLE SHOWING THE INDUCTANCE WITH AND WITHOUT IRON AS A CORE.

Iron.	Per-mea-bility.	Turns.	Length in cms.	Radius in cms.	Induct-ance.
None	1	500	20	10	.04935
With	500	500	20	10	24.675

But another feature worth noting is that of the effect of the increase or decrease of the turns upon the inductance resulting. For instance, it is readily proven that the inductance varies as the square of the turns. In other words, if the turns are doubled the inductance becomes four times as great, as indicated in the following relative table of differences:

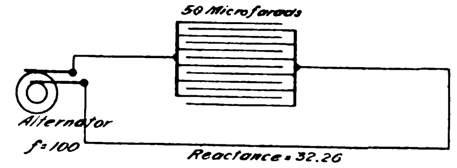
Turns.	Inductance.
1	1
2	4
3	9
4	16
5	25

The exact calculations would show the same result, based upon the fact that the turns are squared in the formula to get L. For instance, in the case given—that of a coil of 500 turns without iron as a core—when the turns are doubled the inductance ought to be four times as great as .04935, or 4 × .04935 = .19740. Calculating with 1,000 turns instead of 500 gives the following value: $L = 4\pi^2 r^2 n^2 \div 1 \times 10^9 = 39.48 \times 100 \times 1,000,000 \div 20 \times 10^9 = 39.48 \times 10^8 \div 2 \times 10^{10} = 19.74 \div 100 = .1974$. This verification can be readily carried out in any other case, thus developing a principle of importance in an industry utilizing variable currents in inductive circuits. *Principle*—The self-induction is proportional to the square of the turns. A further verification could be made by making the turns three times as great, or 1,500, and noting that the inductance resulting would be nine times as great. The coil of 500 turns, with a mean radius of 5 centimeters and a length of 20 centimeters, when used as a basis can become the foundation of a table in which the turns increase systematically. But it is evident that such a table would have to take into consideration the change in inductance, due to the change in the radius of the coil and perhaps of the length as well. But with this demonstration of the fact that self-induction can be calculated from the dimensions and conditions of a circuit, it becomes possible to refer to the reactance of a circuit due to its capacity.



Doubling the turns gives four times the inductance.

Capacity Reactance.—Instead of the capacity in a circuit acting to hold the current back, its effect is just the opposite; it makes the current lead. A condenser of sufficient microfarads capacity, when connected to an alternating source of electricity, brings into existence a new phenomenon, namely, that of the current entering the circuit in advance of the pressure. The reason for this is found in the electrostatic qualities of the condenser itself. It really represents greatly extended terminals of an alternating current circuit; as if the terminals were acting by electrostatic induction to obtain a charge. Being the circuit terminals in a sense, the condenser plates receive their electricity before the potential has reached its maximum value. The effect on a time basis is that of a charge in the condenser before the electromotive force has arrived. This presents the phenomenon of lead instead of lag, as is the case with the impeding effects of inductance. In ohmic equivalents the reactance of capacity may be found by means of the following formula: Capacity reactance = 1 ÷ 2 π f K, where π = 3.1416, f = frequency in cycles per second and K = capacity in farads of the system. For instance, if a circuit has a capacity of .000050 of a farad, equal to 50 microfarads, as ordinarily termed, and the current circulates back and forth at the rate of 100 times a second, the reactance valued in ohms would be 1 ÷ 2 × 3.1416 × 100 × .000050 = 1 ÷ 628.32 × .000050 = 1 ÷ .031 = 32.26. The idea presented here is to show that the reactance due to the capacity and frequency, as well as the capacity due to inductance and frequency, represent tangible values. This is important with reference to the considerations involved in the total effect of resistance, self-induction and capacity. This combination effect, as it may be called, is given the name of impedance.



Capacity reactance in a circuit.

Impedance.—All power transmission circuits are estimated with reference to the impedance. The impedance may be called the combination of reactance and resistance. It is generally expressed in the following form: Impedance =

$$\sqrt{\text{Resistance}^2 + (\text{Reactance})^2}.$$

But it is well known that the forms of reactance are due to inductance and capacity, whose net effects upon each other are such that where related in a certain manner they neutralize each other. For instance, if impedance is to be properly estimated, the formula must be written in such a manner that cognizance is taken of this fact. Impedance, therefore, would be

$$\sqrt{\text{Resistance}^2 + (\text{inductance reactance} - \text{capacity reactance})^2}$$

in its exact form and value. Where the inductance predominates to such an extent that the capacity may be neglected, the formula for impedance becomes

$$\sqrt{R^2 + p^2 L^2.}$$

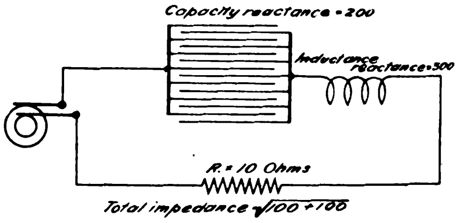
But if the capacity reactance is sufficiently large to require valuation, then the impedance becomes

$$\sqrt{R^2 + \left(p\ L - \frac{1}{pK}\right)^2}$$

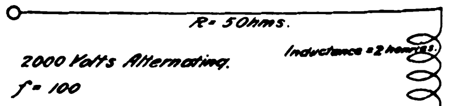
This merely represents an instance of where the capacity reactance is subtracted from the inductance reactance to get the correct impedance. The previous cases could be used as examples, but the following will also serve to illustrate the principle involved. If the resistance in ohms in a circuit is 10, and the inductance resistance 300, then with a capacity reactance of 200, the impedance would equal the

$$\sqrt{10^2 + (300 - 200)^2} = \sqrt{10,100} = 100$$

plus. The resistance effect in this case is almost negligible, for the reason that the reactance operating when squared gives 10,000; whereas the resistance of 10 only gives 100 when squared. An instance of this kind is one in which the resistance plays very little part in the transmission of power. As an example, the following may be given as a case where inductance is the chief factor. A 2,000 volt line has a resistance of 5 ohms, and carries a current of 100 cycles a second with an inductance of 2 henries. The impedance



Impedance due to resistance, self-induction and capacity.


R= 5Ohms.
Inductance =2 henries.
2000 Volts Alternating.
f= 100
Impedance and reactance practically equal to 1051 in ohmic equivalents.

When resistance is low it is negligible compared to the reactance.

therefore is the square root of $5^2 + (2 \times 3.1416 \times 100 \times 2)^2 = 25 + 1,117,249$; which clearly shows how negligible a quantity the line resistance becomes when much inductance is present. The reactance is practically the entire impedance representing the figures 1,057 in ohmic equivalents. On this basis the current in the line would equal 2,000 volts ÷ 1,057, or practically only 2 amperes. The new formula thus appearing for use in connection with this state of affairs would be $C = E \div \sqrt{R^2 + p^2 L^2}$ for the value of the amperes.

Light and Power Problems.—The light and power problems are those which consider efficient power delivery as well as efficient light production. The neglect of circuit conditions is no worse than the disregard of the best means of producing light.

For instance, the expenditure of 1,000 watts for lighting really means the expenditure of more, because of the losses in distribution. It is difficult to grasp the nature of many of these problems, unless the effort is made with the backing of a certain amount of technical knowledge. For this reason the resume preceding these remarks has been made with the intent of presenting certain facts bearing upon the average case. No lines can be strung any great distance, or buried underground, which do not represent cases of the presence of inductance and capacity. The degree to which each are present is largely a matter of the make-up or configuration of the system. Capacity is dependent upon the nearness of one conductor to another, as well as the nature of the dielectric used as insulation. Inductance is dependent upon the number of interlinkings taking place between the conductors respectively and the lines of force. It is thus evident, in the consideration of the conditions existing in light, heat and power problems, that a knowledge of the values of inductance, reactance and capacity, reactance is absolutely essential if a true insight into circuit conditions is desired.

Unless this is done the impedance will not be known at its true value. The current that is to be sent through a circuit will be impeded unduly, and the entire volume of power delivered is apt to be far below the value anticipated. In systems of power transmission and distribution the line losses are generally estimated at a certain percentage of the whole power. The design of the conductor to meet these conditions is, therefore, imperative, if intelligently pursued along the lines indicated.

THE INFLUENCE OF ELECTRICITY ON POWER ENGINEERING.*

BY W. B. ESSON.

The early seventies saw the inventions of Gramme and Von Hefner Alteck and the beginning of the electric lighting era. The first of Gramme's dynamos was brought to London in 1873, but needless to say it little resembled its progeny. Six years before Gramme obtained his first patent Pacinotti had illustrated and described in the "Nuova Cimento" the remarkable machine of his invention, and though this probably embodied in crude form all the elements of Gramme's dynamo, it required the mechanical genius of Gramme to convert into a practical machine what had been till his time a scientific toy. About the same period the Von Hefner Alteneck machine was being developed in Germany, but the early designs of both types were flimsy and built on lines adopted by mechanicians and instrument makers rather than on engineering lines. Soon the designing passed into the hands of engineers, and the flimsiness of the earlier patterns disappeared. From these early days till now progress has been continuous. In 25 years the size of electric generators has increased from 5 hp. to 5,000 hp., from the machines which fed the Jablochkoff candles in the Avenue de l'Opera in Paris to the magnificent triumph of engineering realized in the generators at Niagara.

It was not until 1880 that the first incandescent lamp factory was started on a commercial basis.

From 1880 onwards, power transmission made progress. Arc lighting work had taught manufacturers how to make machines for higher pressures, and the demand consequent on the invention of the incandescent lamp gave the necessary stimulus to development.

There was no such thing as transmission of power in the sense that we now understand it until the electric motor made its appearance.

About 1889, engineers on the Continent were faced with a very important problem. They saw in their waterfalls thousands of horse power running to waste. They knew that by adopting electric transmission this power could be utilized and distributed to great advantage amongst manufacturers scattered over a wide area, but they also recognized that success could only be obtained by the use of a pressure considerably higher than the 2,000 or 3,000 volts then in use. The problem required a considerable amount of study, the position being: For alternating currents, pressure all right, but no motor available; for continuous currents, motors available, but pressure not high enough. As the supply of power was the leading idea, the system which possessed the motor had to be chosen, and continuous current was consequently adopted, with the brilliant device, however, of joining up all the motors in series and spreading the high pressure over the lot, while connecting the generators in series to keep down the pressure on the commutators of individual machines. In this system the current is kept constant, the pressure varying according to requirements, and at the date I am speaking of it does not appear that there was any other way of providing a general power supply. It says much for the engineering of the installations on this system, that they are in most successful working to-day, and what is more, they are being added to in competition with the three-phase system.

Now a system showing such strong vitality, though working on what nine-tenths of our engineers would call antiquated lines, cannot be dismissed in a sentence. The facts are that the system is going ahead in the face of the three-phase alternating system and is successful on a scale commensurate with many of the larger three-phase installations. The Americans say that the success of such a system would be impossible in their country, because the motors would not get there the careful and skilled attention given to them on the Continent. This may be so, but with a large plant and sub-stations the objection need not hold. In any case it is certain that every engineer will look forward with the greatest interest to the completion of the large scheme now in progress.

It was at the Frankfort Exhibition of 1891 that the problem of long-distance transmission was successfully solved. A tremendous impetus was given to power transmission in Europe, and soon a large number of installations were working on the new system, transmitting power to distances up to about 15 miles, at pressures in the vicinity of 5,000 volts or so.

It was not until 1897 that any increase over the Frankfort pressure was made, but in that year the South Californian Power Company transmitted power over 80 miles at 33,000 volts. Several plants were installed at this pressure with the object of finding out whether a still higher voltage could not be successfully employed. These experiments culminated in the Telluride Company adopting, in 1893, a pressure of 40,000 volts for its Provo transmission, and at the present time there are several installations in the States working at this pressure. The Shawinigan Water & Power Company is operating over a line 84 miles long with 53,000 volts. The Washington Power Company, the California Gas & Electric Company, and the Guanajuato Power & Electric Company are all operating at 60,000 volts, while the Kern River Power Company is busy on a line on which the pressure will reach 67,500 volts. This is for the time being the highest pressure in the world, but two companies are making provision for their apparatus to be capable of working at 80,000 volts, so that whenever suitable methods of insulation for this pressure are devised they will be able to adopt it.

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*Abstract of the presidential address to the Civil and Mechanical Engineers' Society, delivered in England October 5, 1905.

In Europe the pressure on transmission lines does not rule high. The distances are not great and under these circumstances it is preferred to keep the line pressure down to a figure which is possible to the generator armatures and does not require the use of step-up transformers. A most interesting example of a power installation in the Far East is furnished by the Mysore transmission of 4,000 hp. from the Cauvery River Falls to the Kolar goldfield, a distance of 92 miles, at 30,000 volts. A scheme which the Scotch Water Power Syndicate have in view is the transmission of 5,000 hp. to the Vale of Leven from a hydro-electric power station, 22 miles distant, supplied with water from Loch Sloy, which is situated 750 feet or so above Loch Lomond. Here the pressure proposed on the overhead transmission line is 40,000 volts. But the scheme is at present in the air and whether the conductors will ever get there I would not like to say.

Unless the power transmitted is very large the lower the pressure the better, provided that it is high enough to allow of the transmission being carried out economically. It would be folly to assert that there are no greater risks with the higher pressures, for, as a matter of fact, with pressures of 40,000, to 60,000 volts "the highest intelligence vigilance and excellence must be employed to avoid accident and insure success." These pressures are not to be used indiscriminately or when they can be avoided. A large number of plants are operating at pressures between ten and twenty thousand volts, and of these it may be said that the overhead lines give very little trouble. The latter figure represents a voltage which can be produced in the armatures of machines of moderate size without difficulty, so this pressure may be considered a limit below which step-up transformers may be dispensed with. When we get much above this we enter a zone where we begin to experience the line troubles which very high pressures bring, without obtaining all the advantages they confer. It is very questionable, therefore, whether there should be any halting place between twenty and forty thousand volts. At thirty-three thousand volts Dr. Perrine tells us that the special difficulties due to capacity, insulator size, erratic lightning arrester effects and switching begin to make themselves seriously felt, and it is just as well, if we have to re-design the apparatus with special reference to these difficulties, that we carry the pressure to the other extreme of the zone referred to, and so get the full return for our trouble. If pressures are ever standardized, the figures for the standards will be probably 20, 40, 60 and 80 kilovolts.

With pressures of the order of forty thousand volts, quite a new set of phenomena is brought to our notice. In the first place, the insulators, in order to prevent flashing over to the supports, must be very much larger and an increase of pressure from twenty to forty thousand volts necessitates their diameter being increased by 50 per cent. or more. A usual size of insulator for the former pressure is 6 inches diameter, while the latter should not be less than from 9 to 10 inches, with the addition of at least one intermediate bell between the outside dome and the inside cup. When these high pressures are used the phenomenon of brush discharge has to be provided against. This results from the breakdown of the air as an insulator, owing to electrostatic strain set up in the space between the wires, and it was very thoroughly investigated by several leading engineers in America in 1893. Their experiments showed that while the loss of power due to this cause at forty to fifty thousand volts was, with the usual line construction, inconsiderable, after the higher figure was reached the loss increased rapidly. Prof. Ayrton has lately worked out the distance wires of different diameters have to be placed apart to insure that with certain pressures there shall be no brush discharge. The cure of the evil is of course to keep the wires far enough apart and keep them large enough in diameter; for it is common knowledge that in the vicinity of a sharp point or a sharp edge less pressure is required to break the air down than in the vicinity of a knob or well-rounded edge. A thin wire presents along its whole length a comparatively sharp edge, and while with wires of one-tenth inch diameter forty thousand volts will discharge through about 10 feet, if the wire is one-fifth inch diameter discharge will only take place when the distance between the wires has been reduced to 15 inches. As it is usual to space the wires on a forty thousand volt line about 48 inches apart, and as in no lines requiring such high transmission voltage, are wires likely to be less than one-fourth inch in diameter, it will be seen that there need be no loss from this cause. But there is enough trouble with switches, lightning arresters and higher pressure surges in the line without brush discharge.

It is not the high pressure that makes the trouble last mentioned, indeed raising the pressure reduces surging, since the current is reduced with the increased pressure. Experience has shown that if a large amount of power is transmitted it is easier to operate lines at a pressure of sixty thousand volts than at a pressure of thirty thousand volts, because in the former case the current flowing is only about half. Suppose we are transmitting 5,000 hp. to a distance of 50 miles at thirty thousand volts. Roughly, the current in each wire will be 80 amperes, and it is possible that if this be suddenly interrupted the surge pressure would rise to twenty thousand volts.

There is no hard and fast rule for pressures to be used, but 1,000 volts per mile is recognized as good practice. This is subject to limitation on the one hand by the highest pressures of which we have commercial experience, and, on the other hand, by the condition that the current in any wire shall not be excessive, a point which has just been dealt with. According to Mr. C. F. Scott, a distance in miles equal to three times the number of thousands of volts may be covered without incurring an excessive annual charge per horse power for copper. But the solution to all engineering problems lies in compromising, and the pressure is eventually settled by striking a balance between the cost and the risks undertaken.

Up to the present I have referred to hydro-electric plants only, and it is not easy to estimate the total of the water power which has been utilized all over the world by their erection. I believe I am well within the mark by placing the total capacity of the hydro-electric power houses at work and under construction on the American Continent alone at a million hp. In Italy, Lombardy alone accounts for 88,000 hp. in hydro-electric power houses at work and under construction, while Switzerland, the home of hydro-electrics, accounts for 220,000 hp. Taking the whole world, the water-power utilized in the hydro-electric stations must be somewhere between a million and a half and two millions of horse power, a vast force, the greater part of which might have run to waste for all time had it not been for the invention of the dynamo.

All of these schemes cannot be placed in the same category. Cases are numerous in which electricity is employed merely as a means whereby the power of water can be conveniently parcelled out to various industrial undertakings in the immediate neighborhood. Such cases furnish an example of power distribution rather than of power transmission.

Needless to say, turbine construction has been influenced to a very large extent by electric power development. The design of turbines has not received much study in England, possibly because here the field of their usefulness is narrow. On the other hand, the subject has been studied exhaustively on the Continent, and it is to books written in another language that we must go for our information.

But if we are backward with respect to water turbines, we make up for this as regards the steam turbine, for if Britain is not exactly the birthplace of the latter, it is the country which has seen its greatest development. To-day there are 600,000 hp. of turbines of the Parsons type at work, and in 21 years the machine has grown from a 10 hp. infant to a 10,000 hp. giant. When it is remembered that the great success of the turbine has been due to the ability, energy and enthusiasm of one man, it is felt that he deserves the greatest and best rewards that engineering has to offer.

I have not touched upon that department of power engineering which concerns itself with railways. It is only 24 years since the first commercial railway was laid down, and to-day the capital invested in street railway undertakings is something in the vicinity of $1,000,000,000.

Brooklyn Rapid Transit's New Chief Engineer.

W. S. Menden has been appointed chief engineer of the Brooklyn Rapid Transit Company in place of Eugene Klapp, who resigned to enter business with W. B. Parsons. Mr. Menden was chief engineer and general superintendent of the Metropolitan Elevated Railroad Company in Chicago.

Edison Electric Lamp Patent Decision.

In Newark, N. J., last week, Judge Cross, of the United States District Court, dismissed the contempt proceedings brought against James McLaren, of Newark, by the Edison General Electric Company. Mr. McLaren was charged with infringing the Edison electric lamp patents, and has been successful in his contention that his process is different from that of the Edison Company.

Electrical Power in Potteries.

The owners of the potteries near Stockholm, Sweden, have been experimenting with electrical power. The results show that as compared with steam electricity is cheaper, handier and quite as efficient.

Proposals Invited.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until November 21 for furnishing Eastern Navy Yards with the following electrical material: Schedule 214, arc lamps; schedule 215, steel conduit, lighting wire; schedule 218, motors, armatures, lamp holders, incandescent lamps, cable, miscellaneous electrical supplies, electric soldering irons; schedule 219, Grimshaw tape. Blank proposals and specifications can be obtained at the Navy Pay Office in New York or upon application to the Bureau at Washington.

ELECTRICAL PATENT RECORD

LETTERS PATENT ISSUED OCT. 31, 1905.

Electric Railways and Appliances.

802,993. Trolley-Wheel Bearing. Robert Kissinger, Columbus, O., assignor of one-half to S.B. Hartman, same place. Filed March 27, 1905.

803,020. Controller for Electric Cars. Francis A. Roche and Francis J. Roche, Somerville, Mass. Filed March 15, 1905.

803,208. Trolley-Catcher. Warren W. Annable, Grand Rapids, Mich., assignor of one-half to J. Watson Fitzgerald, same place. Filed March 31, 1905.

803,210. Trolley-Retrieving Device. Henry B. Clarke, Chicago, Ill. Filed Jan 16, 1905.

803,214. Controlling System for Railway Vehicles and Trains. John J. Crouse, New York City, asssignor, by mesne assignments, to the Westinghouse Electric & Manufacturing Company. Filed Jan. 22, 1903.

803,215. Overhead Structure for Electric Railways. Harry P. Davis and Theodore Varney, Pittsburg, Pa., assignors to the Westinghouse Electric & Manufacturing Company. Filed Oct. 19, 1904.

803,216. Suspension Device for Trolley-Conductors. Harry P. Davis and Theodore Varney, Pittsburg, Pa., assignors to the Westinghouse Electric & Manufacturing Company. Filed Jan. 17, 1905.

03,252. Trolley for Electrically Operated Vehicles Norman W. Storer, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Feb. 15, 1905.

803,365. Electric Railway. Maurice C. Rypinski, Schenectady, N. Y., assignor to the General Electric Company. Filed March 31, 1902.

803,502. Railway Signal System. James C. Mock, Detroit, Mich. Filed Jan. 11, 1902.

Electric Lights and Appliances.

803,245. Plug or Connection for Electric-Light Line-Wires. Charles P. Parnell, New York City, assignor of one-half to Harris M. Fletcher, same place. Filed April 19, 1904.

803,246. Electric-Lamp Socket. Charles P. Parnell, New York City, assignor of one-half to Harris M. Fletcher, same place. Filed May 18, 1904.

803,423. Electric-Lamp Socket. Norman Marshall; Newton, Mass., assignor, by mesne assignments, to the General Electric Company. Filed Dec. 24, 1900.

Electrical Machinery and Apparatus.

802,967. Method of Bonding Electric Conductors. Harold P. Brown, Montclair, N. J. Filed Jan. 3, 1905.

802,994. Terminal-Connector for Electric Conductors. John H. Kliegl and Anton T. Kliegl, New York City. Filed Dec. 8, 1904.

803,136. Electric Switch. John J. Ruddick, Newton, Mass., assignor to the United States Electric Signal Company. Filed Nov. 27, 1903.

803,209. Control System for Electric Motors. Ralph E. Bates, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Feb. 1, 1905.

803,213. Alternating-Current System of Control. Frank Conrad, Edgewood Park, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed April 3, 1905.

803,233. Electric-Control System. Henry D. James, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed April 3, 1905.

803,253-254. Electric Regulator or Controller and Method of Regulating Alternating-Current Electromotive Force. Harve R. Stuart, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed Sept. 26, 1903. Renewed Oct. 25, 1904.

803,378. Control of Electric Elevators. George A. P. Weymouth, Melbourne, Victoria, Australia. Filed April 3, 1905.

803,414. Remote-Control Regulator. John L. Hall and William C. Yates, Schenectady, N. Y., assignors to the General Electric Company. Filed March 20, 1905.

803,442. Apparatus for Short-Circuiting Turns in Armature Coils. John F. Shoemaker, Madison, Wis. Filed April 13, 1905.

803,462. Alternating-Current-Motor Control. Charles E. Barry, Schenectady, N. Y., assignor to the General Electric Company. Filed June 24, 1904.

803,486. Magnetically-Operated Switch. George H. Hill, Schenectady, N. Y., assignor to the General Electric Company. Filed June 18, 1904.

Telephones and Telephone Apparatus

803,199-513. Space Telephony. John S. Stone, Cambridge, Mass. Original application filed June 20, 1905. Divided and last application filed June 29, 1905.

Miscellaneous.

802,981. Wireless Signaling Apparatus. Lee De Forest, New York City. Filed Dec. 10, 1902.

803,010. Insulator, Elmer P. Morris, East Orange, N. J. Filed June 6, 1904.

803,107-110. Transmission of Electric Currents. Isidor Kitsee, Philadelphia, Pa. Filed May 20 and Nov. 28, 1904.

803,108-109-111-112. Electric Transmission of Intelligence and Transmission of Intelligence with the Aid of Electric Energy. Isidor Kitsee, Philadelphia, Pa. First application filed June 24, 1904. Last application filed April 10, 1905.

803,147 Electric Furnace. Edwin Appleby, Chicago, Ill. Filed Jan. 28, 1905.

803,180. Means for Producing High-Potential Electrical Discharges. Oliver J. Lodge, Birmingham, England. Filed Oct. 10, 1904.

803,237. Electric Relay. Isidor Kitsee, Philadelphia, Pa. Filed May 3, 1905.

803,263. Electrolytic Cell. Henry S. Anderson, El Paso, Tex. Filed June 21, 1905.

803,410. Electromagnet. Arthur C. Eastwood. Cleveland, O. Filed April 1, 1904.

803,451-452-453. Rheostat. George E. Stevens, Lynn, Mass., assignor to the General Electric Company. Filed Oct. 1 and 12, 1904.

803,493. Long-Distance Electric Circuit. Mark S. Lewis, Medford, Mass., assignor of one-third to George F. Woodley, Providence, R. I. Filed May 4, 1905.

THE TELEPHONE WORLD.

Telephone Company to Double Its Capacity.

Plans of the United States Independent Telephone Company as outlined from St. Louis, Mo., include the doubling of the capacity of the Stromberg-Carlson Telephone Manufacturing Company's plant in Rochester, N. Y. At present it employs 2,500 people, and is capitalized at $6,000,000. It is said to be the intention of the United States Independent Telephone Company to increase the capitalization of the Rochester Company and to raise the force of workmen to 5,000.

A plant similar to that in Rochester is to be built in St. Louis with a capacity equal to that of the former plant at present. The company in Rochester would provide New York and the eastern section of the country with supplies, while that at St. Louis would supply the companies in that section.

Will Place Wires Underground.

The stockholders of the York, Pa., Telephone Company at a recent meeting voted unanimously to increase the capital stock of the corporation from $200,000 to $500,000 for the purpose of placing the wires of the company's system underground, making important rural extensions to the system, and adding general improvements. Charles H. Lidlie, electrical engineer of St. Louis, Mo., has been engaged to prepare plans for a conduit system for the county.

The North Vancouver telephone system is to be installed within six months. Some uncertainty having existed in relation to the exact time when the system was to be established, Superintendent H. W. Kent, of the British Columbia Telephone Company, states that the telephone company was prepared to go on with the work just as soon as the necessary cable could be procured. There was no doubt that the material would be forthcoming within a few months, and he said that the residents across the Inlet could rely on being furnished with the convenience of telephone communication within a period of six months at the most.

The charter of the South Texas Telephone Company, which is to take over several long-distance telephone lines and local exchanges, has been filed in the office of the Secretary of State. It has a capital stock of $400,000, and the principal office is in Austin. The incorporators are J. A. Quisenberry, of Danville, Ky.; A. E. Schaffer, of Wapakoneta, O.; W. R. Stephens, F. C. Smith, of San Antonio, and J. Boynton, of Waco.

The Texas Independent Telephone Association is now convening in Dallas, holding a two days' session, November 7 and 8. The officers of the association are as follows: President, E. W. Dunaway; secretary, J. B. Earle.

The Brighton, Ia., telephone exchange, formerly owned by G. W. Smith, has been purchased by the Brighton Mutual Telephone Company.

The Stark County, O., Telephone Company is about to spend $173,000 in improvements in Canton and Alliance.

Nebraska Meeting of Independents.

November 11 is the date set for the meeting of the Nebraska Indpendent Telephone Association. It will be held in Hastings in the new building of the Hastings Independent Telephone Company. The purpose of holding the meeting in that city is to allow the members to inspect the new exchange, which, though not yet completed, is said to be noted as a model exchange. W. E. Bell, of York, is president of the association, and F. E. Ebersole, manager of the Lincoln Telephone Company, is secretary.

Telephone Bids.

On November 21 the Bureau of Supplies and Accounts will open bids for furnishing the New York Navy Yard for the naval station at Guantanamo Bay, Cuba, 60 telephones complete and a quantity of porcelain cleats and telephone cable, embraced in schedule 223. Blank proposals and detailed information respecting the above requirements can be obtained at the Navy Pay Office in New York or upon application to the Bureau at Washington, D. C.

A special meeting of the stockholders of the National Telephone Company of Wheeling, W. Va., has been called by Secretary Will C. Handlan for the purpose of considering a resolution authorizing an increase in the capital stock of the company, and also a resolution authorizing the issuing of bonds, and providing for the retiring of outstanding bonds. The increase of the capital stock is contemplated to enable it to branch out and prosecute the various extensions that have been under consideration for some time.

A second telephone system in Detroit, Mich., is opposed by the board of directors of the board of commerce. They would be glad to have the Independent telephones of the State connected with Detroit, but not through the medium of a second system, which would only result in lasting confusion and would mean more poles and wires and increase the danger from contact with deadly currents. Detroit, the directors say, should be distinguished among American cities for attractiveness, and in time all poles and overhead wires should be eliminated. Further, in case of municipal ownership being brought about, the city would have two systems instead of one to buy.

The work of extending the telephone system in and about Danbury, Conn., is progressing steadily. With the completion of the line in Beaver Brook and Great Plain work has been commenced on the setting of the poles for the new line to Lake Kenosia by way of Lake avenue.

The Steinauer, Neb., Telephone Company, incorporated in 1900, recently amended its articles of incorporation, increasing its capital stock from $3,000 to $25,000.

The New Ulm, Minn., Telephone Company lately increased its capital stock from $50,000 to $100,000.

The Steuben County Electric Telephone Company, located in Angola, Ind., has increased its capital stock from $5,000 to $100,000.

Two Systems to Unite.

The death knell of telephone competition in Kenosha, Wis., was sounded a short time ago, when articles were filed at Madison, for the incorporation of the Kenosha Home Telephone Company. The incorporators are Alonzo Burt, of Milwaukee; James Cavanagh and Frank Slosson, of Kenosha. Neither of the Kenosha men are interested financially in the company. The capital stock of the company is $175,000, and it is understood that seven of the nine directors will be Kenosha men. The new company will shortly take over the plants of the Wisconsin Telephone Company and Citizen's Telephone Company in Kenosha and the two will be united. The officers of the new company have not as yet been elected.

The Providence, R. I., Telephone Company has begun the work of laying conduits in the streets of the Pier, preparatory to placing a part of its wires underground in accordance with the terms of the agreement by which the company received an exclusive franchise to the streets of the Pier from the town council last winter. By that agreement the company was to place a certain amount of its wires underground within one year from the date of the franchise and the work is now underway and will probably be completed in about six weeks.

Within a short time it is expected that telephone connection with Los Angeles, Santa Ana, Cal., and other cities in that vicinity, will have been established by means of the Home Telephone Company's system. Two wires are being strung, one to give through service to Los Angeles, and the other, which will also be a through one, will carry the way exchanges.

A local telephone exchange is being built by the Wisconsin Telephone Company at North Milwaukee, like those at West Allis and Wauwatosa. There will be 100 subscribers at the start. No toll charge will be made to North Milwaukee as in the past. Persons within one and one-half miles will be given telephone rates the same as those in Milwaukee.

The American Automatic Telephone Company has been incorporated at Albany, N. Y. Its principal offices are in Rochester, and it is planned to erect a factory for the construction of a device to do away with the "hello" girl. The company is capitalized at $1,500,000. Charles L. Goodrum and J. W. Lattig are the inventors of the device.

The Nebraska Telephone Company will erect a large warehouse and workshop in Omaha. It is the purpose of the company to begin work on this building at the earliest possible moment. as it is needed at once.

With a capital stock of $5,000, the Blooming Grove, Tex., Telephone Company received its charter. The incorporators are J. H. Jones, T. T. Grady and J. B. Germany.

The Jasper County Telephone Company has made connection from Montrose to Newton, Miss. The line will at once be extended south by the way of Louin to Bay Springs.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Albuquerque, N. M.—The Gallup electric light plant, owned by Gregory Page, has been sold to E. C. Allen, formerly manager of the electric light company of this city. The terms of the sale have not been made public, but it is learned that the consideration is about $25,000. It is also learned that the First National Bank is interested in the purchase.

Anaheim, Cal.—An election will be held here November 11, for the purpose of voting on a bond issue of over $50,000 for improving the city's electric light plant, and for extending the water system.

Bamberg, S. C.—At a recent election to decide the question of issuing $15,000 of municipal bonds for the purpose of erecting an electric light plant here, only one vote was cast against the proposition.

Burt, Ia.—The citizens have voted for an electric light plant and waterworks system.

Collierville, Tenn.—R. C. Kinner, of Jackson, Miss., is engineer in charge of the construction of the municipal electric light plant, which is to be equipped for 1,000 16-cp. incandescent lamps and 36 arc lamps. Dr. E. K. Leake, mayor.

Green Bay, Wis.—A deal has been closed by which Sinclair Mainland, of this city, and William Mainland, of Oshkosh, have disposed of their gas and electric plants at Fargo, N. D., to Paul Doty, vice-president and general manager of the St. Paul Gas Light Company, George H. Prince, of St. Paul, and J. W. Smith, of Fargo.

Lawrenceburg, Tenn.—The proposition to issue $25,000 in bonds to establish waterworks and an electric light system was recently carried.

Lockport, N. Y.—The Lockport Gas & Electric Light Company has been granted a franchise by the common council for light, heat, power and refrigerator purposes on all the streets of the city.

Lyon Falls, N. Y.—This place is soon to have electric lights.

Monroe, Mich.—At a special session of the council it was decided to hold an election November 14 to submit to the voters the proposition of bonding the city for $20,000 for a new and up-to-date lighting plant.

New Brunswick. N. J.—A big plant to manufacture an improved electric arc lamp is to be built in this city by the Scott Company.

Oswego, N. Y.—Representatives connected with the proposed new electric light company are circulating among business houses and manufacturing establishments, making contracts with the same at a specified amount, the contracts to commence next spring John C. Knight will be manager of the new power plant.

Oyster Bay, N. Y.—After a fight that has lasted years, the Nassau Electric Light & Power Company has absorbed the Oyster Bay Light & Power Company, and will take possession of the latter's plant here in a few days. Interested in the Nassau company are Edwin D. Morgan, Clarence H. Mackay, Percy Chubb and other well-known men.

Salem, Mass.—An effort will be made to establish a municipal electric lighting plant here. Councilman McSweeney is in favor of such a plant.

Tallapoosa, Ga.—The proposition to issue $10,000 in bonds for the erection of a new and up-to-date electric light plant was lately carried.

West Albany, N. Y.—The streets of this village will soon be lighted by electricity.

Williamston, N. C.—This town wants to correspond with electric companies relative to the installation of an electric light plant. Address S. J. Everett, secretary of the Business Men's Association.

STREET RAILWAYS.

Athens, Ga.—The Secretary of State has granted an amendment to the charter of the Athens Electric Railway Company, under which it will increase its capital stock from $100,000 to $125,000, the additional amount to be in preferred stock.

Atlanta, Ga.—The Atlanta & Carolina Railway Company, which has perfected plans for the construction of an electric trolley line from this city to Anderson, S. C., running through Gwinnett, Jackson, Banks, Franklin and other counties, was recently granted an amendment to its charter by Secretary of State Phil Cook, under which it will be permitted to run also through Rockdale County and through Conyers by way of Lithonia in De Kalb. Hon. John R. Hosch, of Hoschton, Jackson County, who is largely interested in this line, stated that the company had about made its final arrangements and would within the next few weeks begin the construction of its line.

Atlantic City, N. J.—The city council has granted the Central Passenger Railway Company a franchise to build a trolley line over the west side district to Marmora avenue and Pleasure Bay. Eventually the line will cross Beach thoroughfare at that point and run directly to the mainland.

Bay City, Mich.—Edgar H. Whitcomb is president of the Detroit-Bay City Traction & Electric Company, which will build the electric railroad from this city to Detroit.

Boonville, Ind.—It is the intention of the Evansville & Newburg Electric Company to extend its lines from this city, to which point it is now building up through Lynnville in Warrick County, thence through Oakland City.

Buffalo, N. Y.—At a meeting of the State Railroad Commission on December 5 the application of the Buffalo & Rochester Traction Company for a certificate of necessity will be considered. The company succeeds the Buffalo & Rochester Electric Railway Company, now in process of voluntary dissolution.

Butler, Pa.—The work of grading the new trolley line is now in sight of this city.

Henrietta, N. Y—This town has granted a franchise to the Caledonia, Scottsville & Rochester Electric Railroad.

Hoboken, N. J.—K. B. Conger, secretary of the Hudson Street Railway Company, states that property owners everywhere are signing consents for the new trolley system that his company is planning to install in Hudson County.

Marysville, O.—Indications show that the Columbus, Urbana & Western Electric Road, which is in the hands of the Schoepf Syndicate, will be built through Union County,

Mattoon, Ill.—The Secretary of State has issued a license to incorporate the Decatur, Sullivan & Mattoon Transit Company. The principal office is to be here The capital stock is nominally $25,000. It is proposed to construct an electric railroad from this city in a northwesterly direction to Decatur. The incorporators and first board of directors are R. J. M. Clokey and J. H. Culver, Decatur; George B. Spitzler, Mount Zion; John R. Hamilton and Edward C. Craig, Mattoon.

Milwaukee, Wis.—The Milwaukee Northern Railroad Company, incorporated with a capital of $100,000, by John E. Uselding, of Port Washington, and John M. Seaman, of Sheboygan, intends to build an interurban electric line from Sheboygan to this city.

Salt Lake City, Utah.—The county commissioners have passed an ordinance granting to J. F. McCarron a franchise to operate an electric railway in Weber County. Although the franchise affects the county alone, it is understood that the proposed line is to become a part of the Eccles roads, connecting at the southern limits of the city with the line of the Ogden Rapid Transit Company's tracks, and at the northern limits of the city with the tracks of the Ogden & Northwestern Line, which now extend to the Hot Springs.

Wappingers Falls, N. Y.—It is claimed that a trolley line will be constructed early in the spring to connect this place with Fishkill.

Winona, Ind.—The trolley line that was to have been built from Wabash to this city has been proposed for a different route. Instead of Wabash being one of the terminal points, the line will be operated between Peru and this city.

POWER PLANTS.

Salt Lake City, Utah.—Irwin E. Pratt, secretary of the Blue Bench Co-operative Water Company, has made application in the State Engineer's office for the appropriation of power to be taken from the Green River system in Wasatch County. The diverting channel is to be 36,500 feet in length, 18 feet in width and 4 feet in depth.

Woodstock, Ala.—Smith & Weaver want information as to the cost, etc., of a small power plant to operate a barrel factory.

Walla Walla, Wash.—The Northwestern Gas & Electric Company has increased its capital from $15,000 to $1,000,000. It is hinted that the company has plans under way for the construction of another huge power plant.

BIDS WANTED.

Alton, Fla.--Clarence H. Ellis wants bids on both direct connected 45 kilowatt generator set and on 45 kilowatt belted generator, 60 hp. engine, and 75 hp. return tubular boiler, also on a 35 kilowatt generator set as above.

Shenandoah, Va.—D. S. Louderback, mayor, will receive bids until November 21 for furnishing this city with electric lights and motor power.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 16⅝@16¾c.; Lake 16⅝@16⅝c.; casting, 16⅛@16⅜c.

The General Electric Company semi-officially announces that it does not contemplate the acquisition of any other electrical concern.

The Allis-Chalmers Company will soon remove its business from Chicago to its $3,000,000 plant now nearing completion at West Allis, Wis.

H. W. Parsons, cashier of the American Banking Company of Sandusky, O., has been appointed receiver of the Warren Electric Manufacturing Company of that city.

Stockholders of the Southern New England Telephone Company, at a recent meeting, voted to increase the company's capital stock from $5,000,000 to $10,000,000.

The Southern Traction Railway Company, which proposes to build a trolley line from Altoona to Roaring Springs, Pa., has made a mortgage to secure $500,000 six per cent. 10-year bonds.

The Brooklyn Rapid Transit Company's gross earnings for October have shown, it is reported, an increase of about $175,000 over October, 1904, and an increase of about $5,750 per day over last year.

The Chicago Edison Company has ordered two 8,000 kilowatt steam turbines and generators. These machines are each capable of developing 18,000 hp. This order is a duplication of one formerly from the same company for two similar machines.

General Electric was adversely affected by the announcement of a proposal to increase the amount of its capital stock. Wall Street argued that the value of the prospective rights was a relatively small consideration in comparison with the possible effect on the floating supply.

It is fully expected that the back dividend on United Railways Investment Company, of San Francisco, preferred stock will be paid the first of the year, in cash or some obligation worth par of the accumulated dividend, and that the preferred stock will be established on a full 5 per cent. basis.

The common stock of the Philadelphia Company crossed par Friday. For a month past experts representing Ladenburg, Thalmann & Co. of New York and foreign interests have been inspecting the property. It is understood that control is being bought. The company has an omnibus charter and controls the natural and artificial traction and lighting franchises of Pittsburg.

An important meeting of the directors of the Metropolitan Securities Company of New York was held Friday. While no action was taken, it is understood that the advisability of issuing a statement of the company's condition was discussed. It is not unlikely that such a statement may be issued after the next meeting of the board. There is no intention at this time of calling an additional subscription on Metropolitan Securities stock.

The termination of the written agreement between the Brooklyn Rapid Transit Company and its motormen will result in the increase of pay of some of the men. When the road was changed to electricity the old engineers were taken over as first-class motormen at $3 a day and the firemen were made second-class motormen at $2.50 a day. The second-class motormen will now be raised to the first-class. New applicants will be employed as second-class motormen for one year at $2.50 a day

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Nov. 3
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	210
Manhattan Elevated Railway	166
Metropolitan Street Railway	121⅝
Metropolitan Securities	78¼
Ninth Avenue	197
Third Avenue	124⅞
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	76
Brooklyn City Railway	239
New Orleans Railway	38
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81½
Philadelphia Traction	100¼
Union Traction	62¾
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	13
do. do. do. pref	56
West End Street, com	99¼
do. do. do pref	114½
Chicago.	
City Railway	192
North Chicago	83
Union Traction, com	10¼
do. do. pref.	42½
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	19⅜
do. pref.	62
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	15¼
do. do. pref.	22
Westinghouse, com	168¾
do. pref.	197
General Electric	186
Boston.	
Edison Electric Illuminating	248
General Electric	185
Westinghouse Electric & Mfg., com	85¼
do. do. do. pref.	100
Chicago.	
Chicago Edison	163
National Carbon, com	62¼
do. do. pref.	116
Philadelphia.	
Electric Company of America	11⅛
Electric Storage Battery, com	83¼
do. do. do. pref.	83¾
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	136¾
Western Telephone Company	13
New England Telephone Company	138
New York.	
American Telegraph & Cable Company	93
Commercial Cable Company	210¼
Mexican Telephone Company	1
New York & New Jersey Telephone Company	172¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93
Chicago Telephone Company	138
MISCELLANEOUS STOCKS.	
Chicago Subway	48¾
Otis Elevator Company	61
Standard Underground Cable	..
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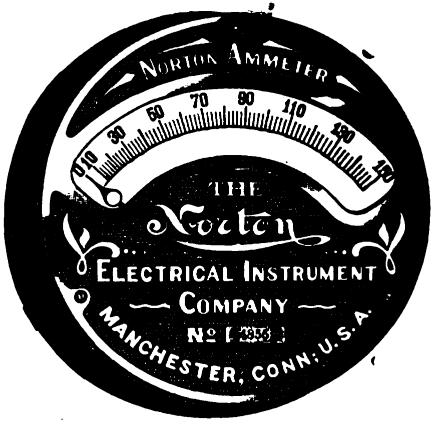
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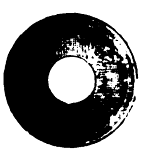
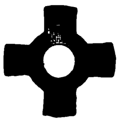
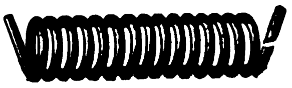

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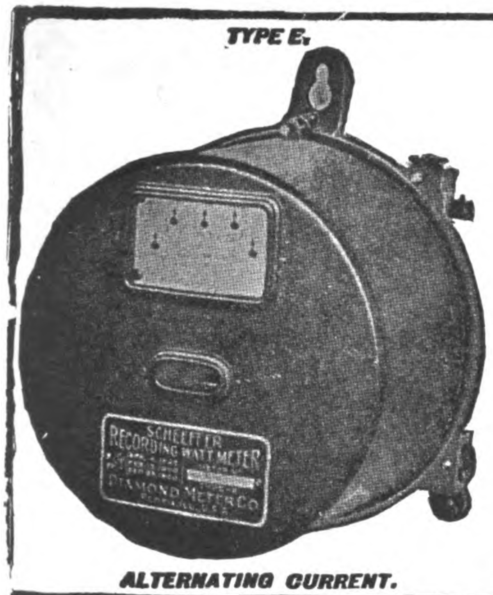
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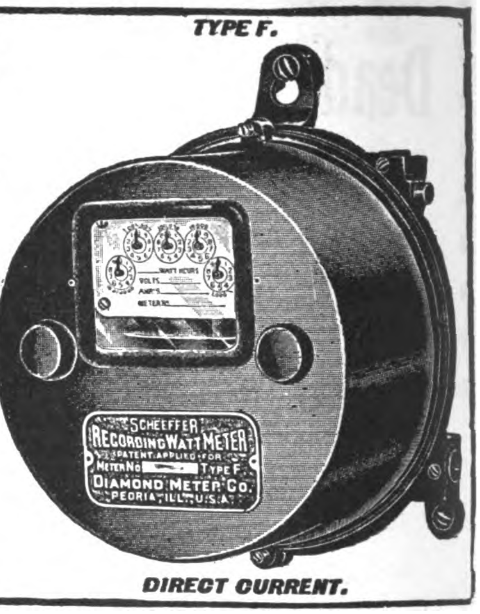
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TYPE F.
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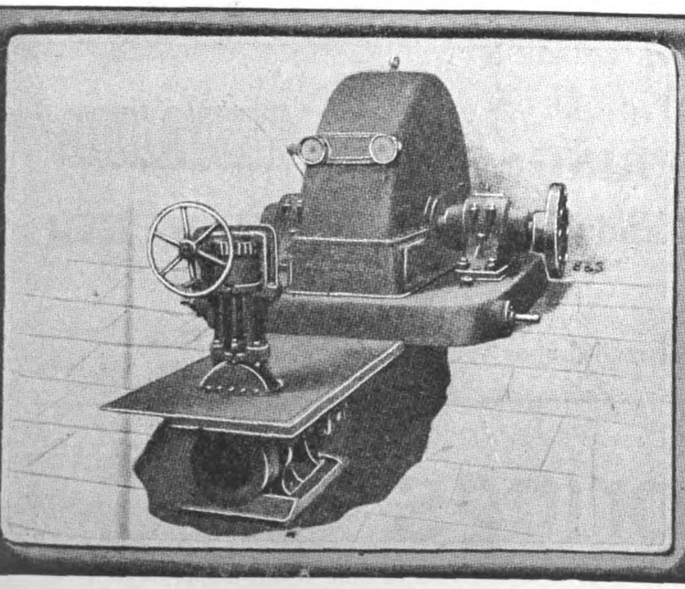
DIRECT CURRENT.



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ELECTRICITY.

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EDITORIAL NOTES.

Risks Small, Profits Large.

An interesting book on telephone development has made its appearance. The author is Mr. F. S. Dickson, president of an Ohio telephone company. He states among other interesting things that a telephone company as an investment is wholly free from some of the commoner forms of risk. During times of general prosperity it reaps an advantage in the average inincrease in values, and suffers less, according to the author, when hard times come.

As it supplies a necessity of life its income is stable and the number of telephones may increase largely and steadily. It does not have to remove its exchange because of a change in the business center of a city. It is easy for it to extend its cables to supply increased demands. A large proportion of its property may be economically shifted to meet varying public needs, and new lines begin to earn money before the bills for labor and material are due. It does not make things to sell and therefore carries no large stock of goods, nor does it need to hold idle vast quantities of raw material. While the junk value of its plant is very high, there is little likelihood of its property ever being sold as junk. Its loss from friction need not be taken into account, from weather conditions is ordinarily slight, and from accidents infinitesimal. Properly maintained, its depreciation from natural causes is but little, and from the changing character of business far less than for a manufacturing or transportation company. It offers good rates for its bonds and promises with reasonable certainty handsome dividends on its stock.

Mr. Dickson is an authority on telephone matters, and it is fair to presume he knows what he is writing about. Such being the case and as the financial risks are so small in the telephone business, we should like to inquire why the public puts up with the exorbitant charges of the Bell companies?

* * *

The Puncturing of Insulation.

When insulation is punctured by means of a direct current it takes a pressure bearing some relation to the resistance of the insulation affected to break through the medium under stress. The manufacturers of high tension apparatus are particularly interested in the conditions which make insulation give way. The two expressions, insulation and dielectric, are synonymous in so far as the weakness betrayed by the insulation and the amount of inductive action are concerned. The degree of pressure developed ordinarily in power-carrying wires will not break through its protective covering as a rule. But extraordinary conditions prevail at times, with the result that it does give way, and in a most astonishing and apparently unexplainable manner. Perhaps the most familiar case to the general reader is that of lightning bursting through various forms of insulating materials, such as poles, windows, chimneys, trees, etc. A terrific potential like this, however, is that of inductive action due to it; a potential induced in neighboring bodies which, if sufficiently high, culminates in a disruptive discharge.

The ordinary puncture of insulation, by which is meant the breaking through of the covering of wire, is not caused by the normal pressure of the wire. It is due to conditions developing within the circuit, which give rise to a very high—an abnormal potential—for a series of intervals of time. The inductive action in this case is caused by electro-magnetic influences, primarily aroused by the self-induction within the circuit. It is best understood as a case of where the circuit, such as a transformer, for instance, develops within itself, when the self-induction and capacity are properly related, a condition of resonance.

Under these conditions the circuit can build up a very high electromotive force, sufficiently high with only a reasonably low pressure to break through the insulation. If the transformer takes one or two thousand volts, and the internal coil conditions permit the reactions spoken of to exist, then it is possible that a pressure of many thousands of volts will strain the insulation to its breaking point. What is meant here is that the electrical energy, under conditions which make the electrostatic capacity and self-induction balance, gives rise to a potential which threatens the integrity of the insulation. To present the facts even more clearly, it is as though certain influences were operating in a pipe carrying running water, which tended to fracture the walls of the pipe. While it is well known that by suddenly turning off running water an effect of shock is produced, called the water hammer, an effect which will burst weak pipes, the effect meant here is different only in so far as it is produced by an alternating flow of current. If the walls of a pipe are weak they can evidently be broken by an hydraulic impact, and in a similar manner if the insulation is weak it can be punctured by an electrical impact. While the two cases are not identical, they serve to illustrate the idea that in certain circuits carrying a comparatively low pressure alternating current a disruptive potential may be engendered that will cause severe damage unless understood and eradicated. Transformers represent such an instance, as shown at times by the complete breakdown of their insulation when in ordinary service.

* * *

An English Awakening. An important movement has been set on foot in Great Britain with a view to awakening among the masses of the English people an interest in, and belief in, the powers of science, such as have been long noticeable to a far greater extent among the people of the United States and of some European countries. The scientific spirit, it is complained, though so essential to all true progress, is still rare, and is too often lacking in an almost incredible degree in some of those who are responsible for the conduct of many of the British national activities. The movement to which we have referred, and whose object it is to remedy the evil and bring home to all classes the necessity of applying scientific treatment to affairs of all kinds, has now developed into what has been termed the British Science Guild. In this guild there being brought together a very large number of leading men interested in all different departments of science, including Lord Kelvin, Sir William Crookes, Prof. George Darwin, Sir Archibald Goikie, Sir Norman Lockyer, Professors Ayrton, Perry, S. P. Thompson, and so on; but it is by no means confined to scientists, for it includes representative leaders of all the great industrial and manufacturing organizations of that country, educational authorities, and indeed all branches of human endeavor whereon a beneficial effect would be felt from the wider applications of scientific method. The inaugural meeting of the guild was held in London under the presidency of the Lord Mayor on October 30, and many interesting speeches were delivered which excited the enthusiasm of a goodly gathering of sympathizers and gave the movement a good send off. To these speeches we need make no more than the briefest reference. Their purport was: If the English as a manufacturing nation wish to stand out prominently in the competitive struggle between the nations of the world, there must be an end to the apathetic treatment of scientific men and methods by Government departments; that the niggardliness of the Government in making grants to universities and other institutes where scientific education is imparted must end; that the "common people," if we may use a convenient though sometimes objectionable term, must be taught to think; and that the aptitude for scientific application shall be secured to the industrial worker in the factory as well as to the employer and the manager.

The latest bulletin from the so-called "electrical press bureau" is as follows: "The impression that J. P. Morgan and his friends hold a controlling interest in the General Electric Company is wrong. A majority of the stock is held by New England people. Westinghouse securities are very closely held by Pittsburg interests. Neither the Westinghouse nor the General Electric Company is endeavoring to secure control of the Allis-Chalmers or the American Locomotive Company."

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Clarence S. Darrow of Chicago, Mayor Dunne's expert in traction litigation, has resigned, "because he is disheartened that not one thing has been accomplished by municipal ownership followers."

The Japanese Minister to this country is making a thorough study of the manufacture of electrical machinery, and will report to his Government in December.

Prof. H. S. Carhart, of the University of Michigan, who recently went to Berlin, and participated in the conference on standards, etc., at the Reichsanstalt, is now visiting the Bureau of Standards at Washington, in connection with this work.

Manufacturers of gasoline motor trucks are up in arms because their vehicles are barred from many of the docks and piers in New York, while there is no objection to electric trucks.

The Brooklyn Rapid Transit Company is the largest street railway corporation in the world. It operates 538 miles of track and 3,600 cars, carrying on the average 2,000,000 passengers a day. The company has, within six months, spent several million dollars for additional electrical equipment.

A cable dispatch from Paris says the repeated complaints of the Parisians on the subject of the poor telephone service of Paris have at last spurred the Ministry of Posts and Telephones to institute reforms. The antiquated plant is to be replaced by a new one which will cost the Administrative Commission $10,000,000, and the general working of the system is to be operated on the American plan.

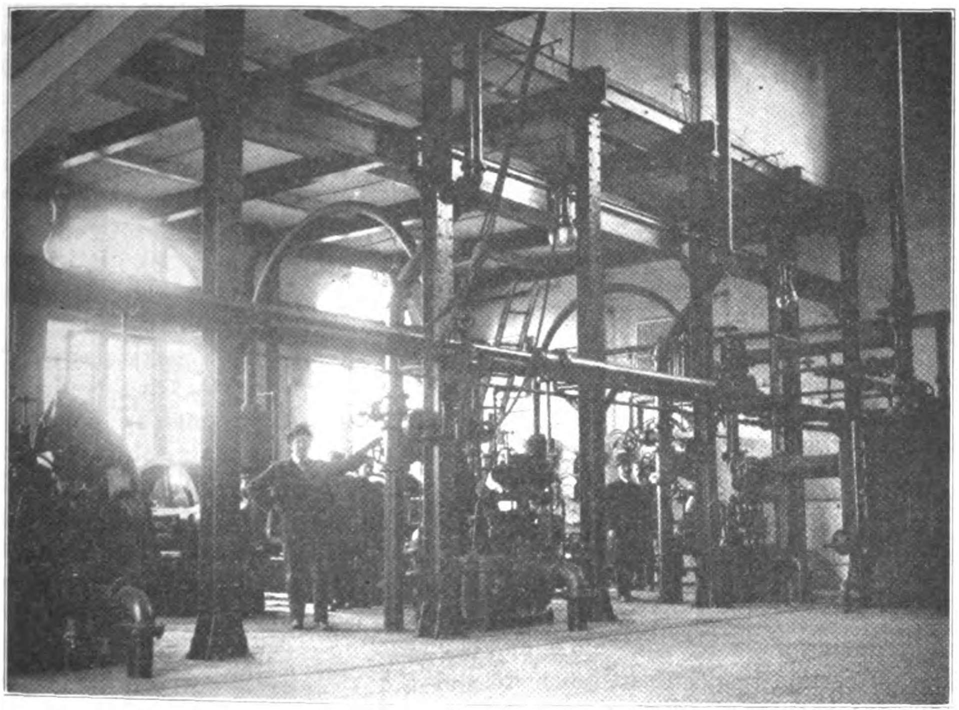
The Magnetic Club will hold its annual autumn meeting at the Hoffman House, New York, this (Wednesday) evening, November 15. Dinner will be served at 6:30 o'clock. Delegates to the annual meeting of the Telegraphers' Mutual Benefit Association, which will be held the same day, will be guests of the club.

Lieut. Ettore Rota, of the Italian Navy, has invented an apparatus for protecting crops from destruction by hail. One of the chief features of his invention is the use of the Hertzian waves. Lieut. Rota has carried out several successful experiments and has been warmly congratulated by the Italian Goverment.

AN EXPERIMENTAL MUNICIPAL LIGHTING PLANT IN NEW YORK.

BY IRVING THOMPSON.

European cities for some years past have been trying to extract the heat or fuel value from certain kinds of rubbish collected by the street cleaning departments. They have undertaken experiments and systematically employed means for advantageously disposing of that class of refuse which they believed would yield specific and profitable returns.

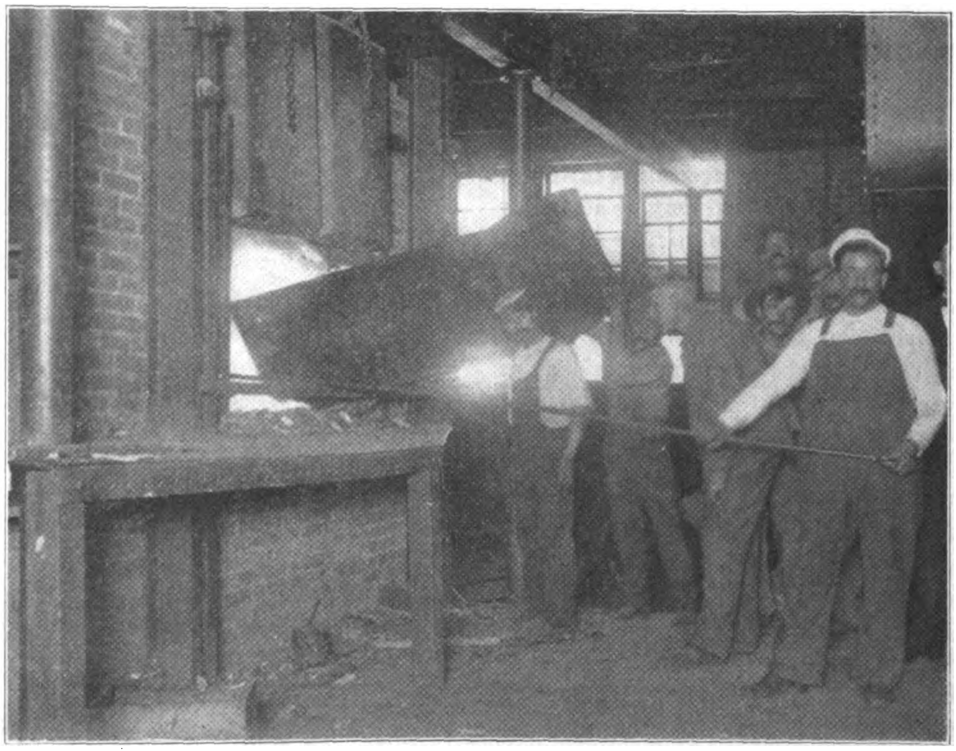


Generating Station of New York's Municipal Lighting Plant.

American cities on the other hand have paid no attention to this phase of rubbish removal, except in so far as they could have it removed quickly and completely from their sight. To facilitate this work they have been accustomed to paying large sums to contractors for its removal from the city streets. The reports proceeding from certain European cities have been the stimulating cause of an interest which crystallized in a determination to try a similar experiment in New York.

Two plants are now in operation based upon these theories, the second of which is described and illustrated in this article. Both plants make a point of consuming rubbish collected from the streets. This rubbish might be described as consisting of the following: Paper of all descriptions including cardboard; wood, including old furniture with its stuffing, barrels, boxes, etc. This material is burnt and its heat of combustion used to generate steam for operating an electric light plant, and supplying steam heat to public schools in the vicinity.

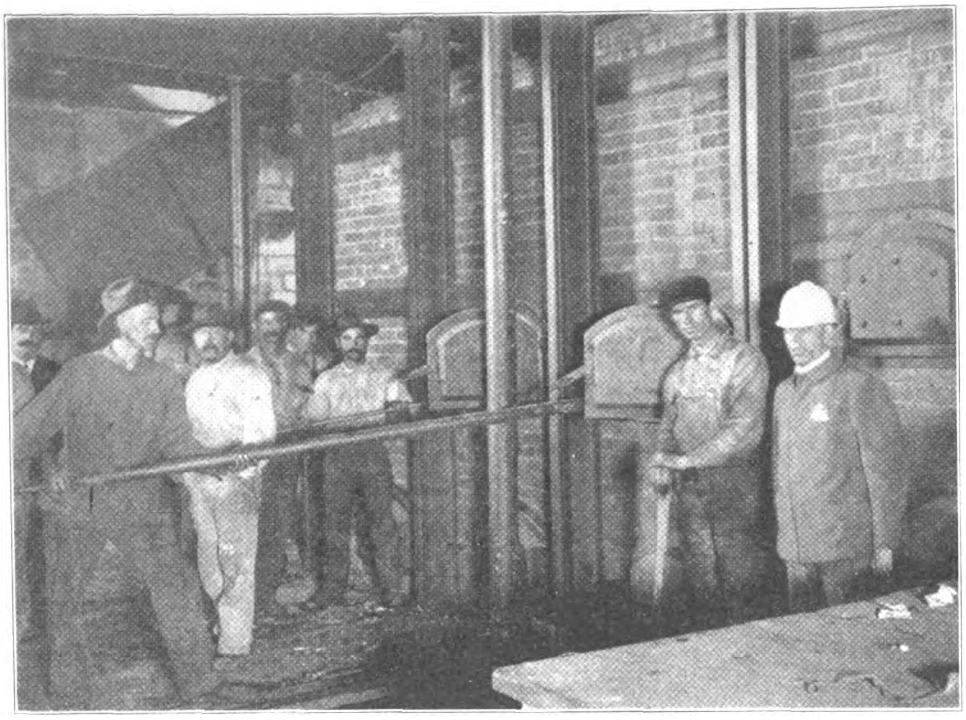
The plant illustrated was started up on October 30. It is situated directly under the new Williamsburg Bridge at Delancey street and the East River. The equipment is contained within two buildings, one housing the furnaces and boilers, the other providing accommodations for the generating plant. The first building covers an area approximately 150 feet by 70 feet and is 30 feet in height. In it the rubbish is received on the lower floor, and is dumped directly from the street wagons on to an endless conveyor, which carries it up an incline to a platform above the furnaces. This conveyor travels at the rate of 60 feet a minute, and as it carries the waste material upwards a gang of sorters pick out the material which in their experience would interfere with combustion. Several men and boys are stationed on either side of the conveyor, making the final sorting process a means of eliminating such unwieldy articles as would be likely to clog the chutes leading to the furnaces or limit the intensity of the active combustion.



Placing an Old Lounge in Furnace of New York's Municipal Lighting Plant.

When the matter reaches the top of this conveyor it falls on a sheet-iron platform containing openings which lead into three of the four furnaces. Through these three separate chutes the rubbish is pushed down by men with shovels. Owing to the draught caused by the chimney, built in connection with this plant, of a height of at least 80 feet, there is no possibility of the heat or flames coming up through these chutes and affecting the workers above. Back draught in this construction has been entirely eliminated, thus supplying an indispensable element of safety in conjunction with this class of work.

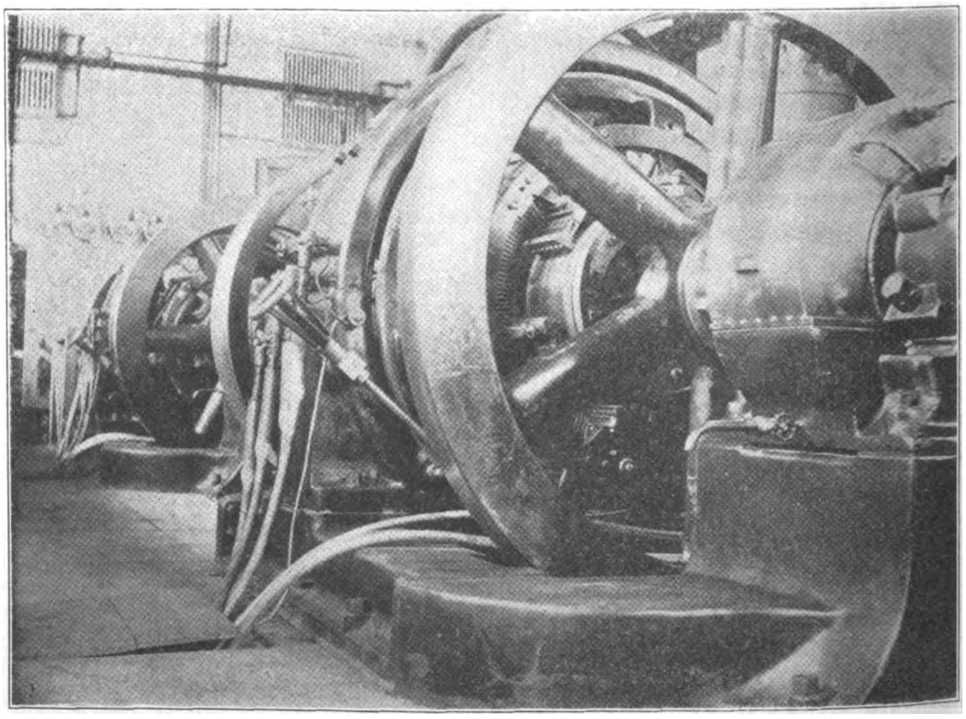
Along the outside of the building an inclined wagon way has been constructed, which is used only by the drivers whose wagons contain material requiring neither picking nor sorting. The fourth furnace is thus called into requisition, for it is utilized to consume the material from such wagons, which is dumped directly into a chute leading to it. By this means time and labor are saved which contribute directly to the financial advantages claimed by this scheme of disposing of waste material.



Firing Gang at Work in New York's Municipal Lighting Plant.

Such material as large pieces of lumber, entire barrels, old sofas and chairs, etc., which could not be dropped down through the chutes are thrown directly into the furnaces through the firing doors on the lower floor. The light and highly combustible nature of the material consumed in conjunction with the heavy draught caused by the chimney prevents any unusual waste of heat taking place when the furnace doors are opened as described.

A novel feature of the plant is the direct separation of the furnaces from the boilers. Advantages are derived from this arrangement, which may be stated as follows: First, the combustion is made complete so that the generation of smoke is practically impossible. Second, the use of the combustion chambers of the furnaces is thereby made independent of the use of the heat for making steam in the boilers. In other words, if the rubbish is to be burnt at a time when it is not deemed desirable to generate steam to do electric lighting, the plant merely represents a rubbish destructor. On the other hand, if steam is being generated, a series of short flues connecting furnaces and boilers, are opened by means of dampers, thus permitting the heat to play upon the boilers for the purpose intended, and at the same time supplying a means of consuming the smoke. This feature is of prime importance, because the bridge level and top of the chimney are in sufficient proximity to otherwise cause annoyance to passengers and pedestrians. Indirect connection, therefore, represents a means of overcoming a salient objection to the combustion of smoke-producing material, the smoke of which is in certain respects as much a fuel if properly utilized as the material itself.



Dynamo Room of New York's Municipal Lighting Plant.

It may be interesting to note in connection with this form of construction that the dampers, by means of which the flues are opened or closed, are made of fire-brick and not of iron. In this peculiar class of work, where smoke consumption, rubbish burning, steam generation and electric lighting are all carried on together, it is necessary to make provision for the preservation of each part of this equipment against the ravages of a variety of temperatures, when such part is exposed to the varying degrees of heat and flame. Dampers made of iron do not resist these influences sufficiently well, and it has been found necessary to substitute fire-brick in its place. Another reason is to protect the boilers from the heat of combustion when they are temporarily out of commission.

Two Sterling boilers are employed which have a rated capacity of 200 hp. apiece. They are built in and supported in the usual manner by a brick foundation. The present capacity of the plant is 160 loads of rubbish a day, each load weighing 1,000 pounds. The handling of this material in this particular department of the plant calls for the efforts of 25 employes. These men are engaged to pick and sort the material, to fire the boilers, and to oversee the work. The peculiar situation presented here is that of the Department of Street Cleaning superintending the handling and combustion of the rubbish, in fact, this particular building is entirely in its charge, and the responsibility for its proper supervision rests upon its shoulders. On the other hand the lighting plant, which is, as stated, installed in a separate building, is directly under the management of the Department of Bridges.

Previous to the installation of this plant the city of New York was spending 30 cents a cubic yard to dispose of its waste products; calculations based upon the operation of the present plant have not as yet been made with sufficient accuracy to present reliable statistics on the subject. Part of the residue of combustion from the furnaces has been turned to profit by being packed and shipped to tobacco growers, who find this quality of ash of particular service to them in that industry. In addition, much of it is placed on scows and used in various sections of the water front for filling.

The electric plant utilizes the steam at night for lighting the Williamsburg Bridge, and during the winter season the public schools in the immediate neighborhood are supplied with steam heat. It has been estimated by Mr. F. L. Stearns, the engineer of the Department of Street Cleaning, who designed and built the rubbish-consuming plant, that one pound of the material burnt in the furnaces is capable of evaporating one and a half pounds of water from 212 degs. Fahrenheit. This means that condensed steam returned to the boilers can be, like any other plant, economically utilized. If the water is below 212 degs. Fahrenheit, it is evident that more than one pound of rubbish will be required to evaporate one and a half pounds of water. On this basis a calculation made, resting upon the belief that 24 pounds of steam are necessary to produce one horse power hour, the division of 24 by 1.5, giving 8, would show that 8 pounds of rubbish are necessary to develop an equivalent amount of power. A calculation of this character would tend to show that every wagon load of 1,000 pounds of rubbish dumped into the furnaces would develop 125 hp. hours. An estimate of the number of horse power hours required in the form of electrical energy to do the lighting of the bridge would be a means of calculating the number of wagon loads of rubbish necessary to provide an adequate supply of heat energy. On the basis established, derived from the figures given, about fourteen 16 cp. incandescents, or two inclosed arcs, could be lit one hour from the heat obtained by the combustion of eight pounds of rubbish. Both the labor bill and the rate of depreciation must be included in any calculations giving rise to practical data on the subject.

The electric generating plant is necessarily merely the recipient of this mechanical energy developed through the boilers and engines. It is situated in a building 60 x 30 feet in area, adjacent to the rubbish-consuming plant, on the lower floor of which is installed the generators and engines. There is an upper floor covering about one-fourth of the area of the building, which will be used as a storage battery room when equipped. This last system will be a sort of buffer between the fluctuating steam pressure and the electric lighting. It will also serve to take care of the load where an excess of energy is developed. At present there are three generating units consisting of cross compound Ideal engines direct-connected to Burke generators. Two of these engine units are of 100 hp., and one is of 75 hp. capacity. The three-wire system is employed throughout; the potential across the positive and negative leads being 240 volts.

In connection with the steam plant it may be stated, in conclusion, that the steam after passing through the cylinders is sent into Cochrane oil separators and into condensers. The customary and economic measures in all modern steam and electric plants are put into service to gain as high an efficiency as possible when and after the steam is used. Artesian wells have been sunk to gain a water supply for boilers and circulation around the condensers, and in addition to avoid an expense which would otherwise exist for condensing purposes.

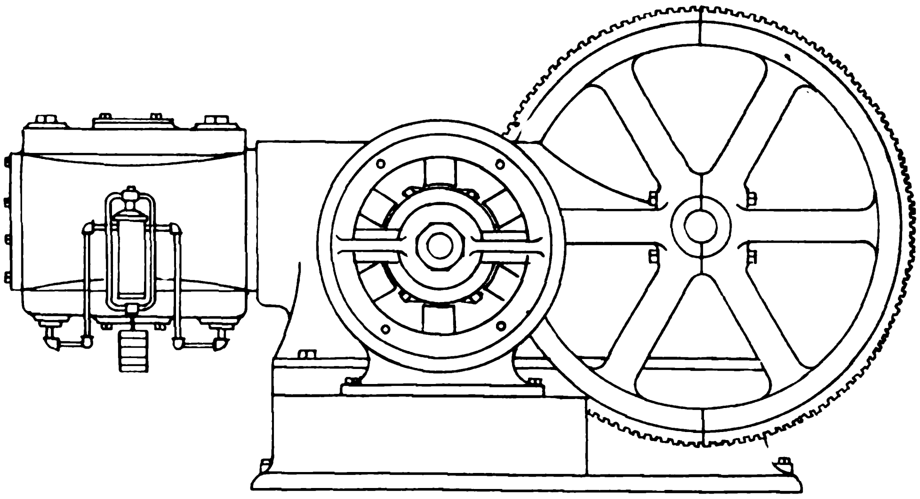


FIG. 1.

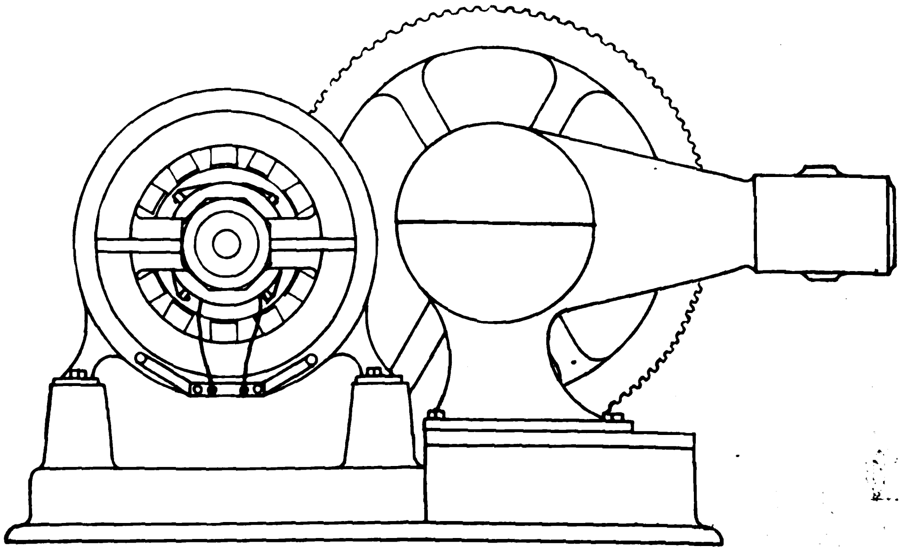


FIG. 2.

The buildings are fireproof throughout with cement floors and steel girder construction. Engines and dynamos are mounted on the same bed-plate, as illustrated. The switchboard consists of eight panels arranged as follows: Four feeder panels, one meter panel and three generator panels; the necessary circuit breakers, non-arcing fuses, switches, etc., including lightning arresters, are supplied to equip this center of distribution.

MOTORS IN BOILER SHOPS.

BY W. H. WAKEMAN.

A steam engine of some kind or description is usually found in every boiler shop, as power is required for various purposes. Some of these shops are driven by first-class engines that are cared for by competent engineers; while others have to get along with fourth rate machinery.

Compressed air is used for various purposes, such as driving rivets, chippers, caulkers, etc., thus displacing a vast amount of hand labor. Steam-driven compressors are sometimes located in these engine rooms, where they prove to be objectionable on account of the noise they make and the vibration they cause.

Not far from where I am writing this article, there is a fine boiler shop driven by a good Corliss engine in charge of a very competent engineer. The engine room would be quite a comfortable place, were it not for a large steam-driven compressor, which makes so much noise that communication must be carried on by shouting, as ordinary conversation cannot be heard. This is not only an annoying condition of affairs, but it prevents the engineer from hearing noises which indicates that some part of his engine or pumps needs attention, by which warning he is often enabled to avoid serious trouble. It must be a serious defect indeed that would cause noise enough to be heard in that engine room, yet somebody must spend many hours per week amid its discomforts.

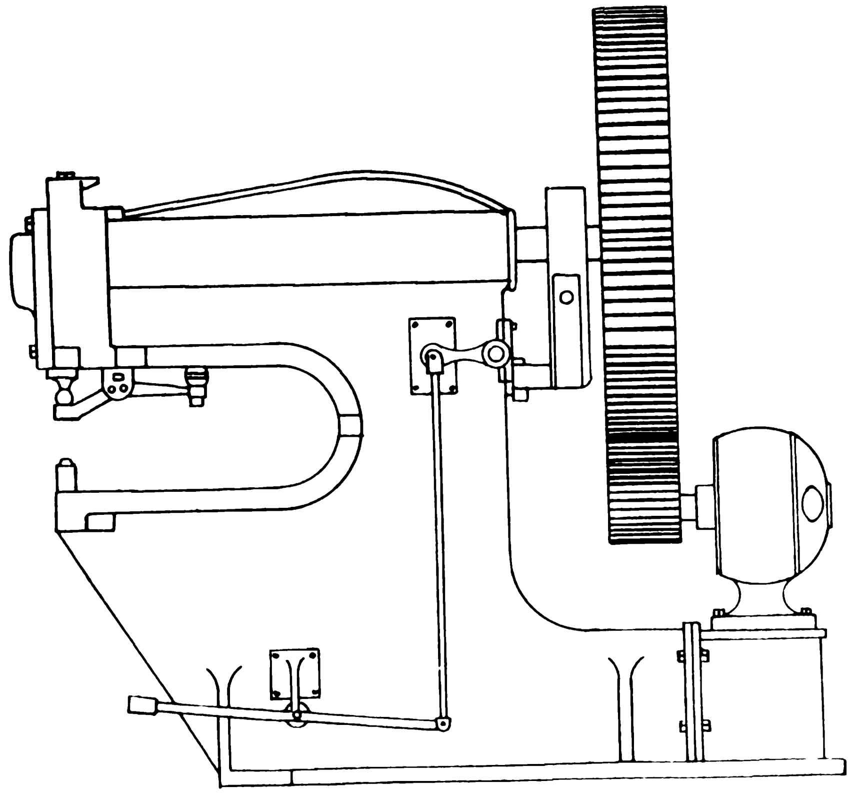


Fig. 3.

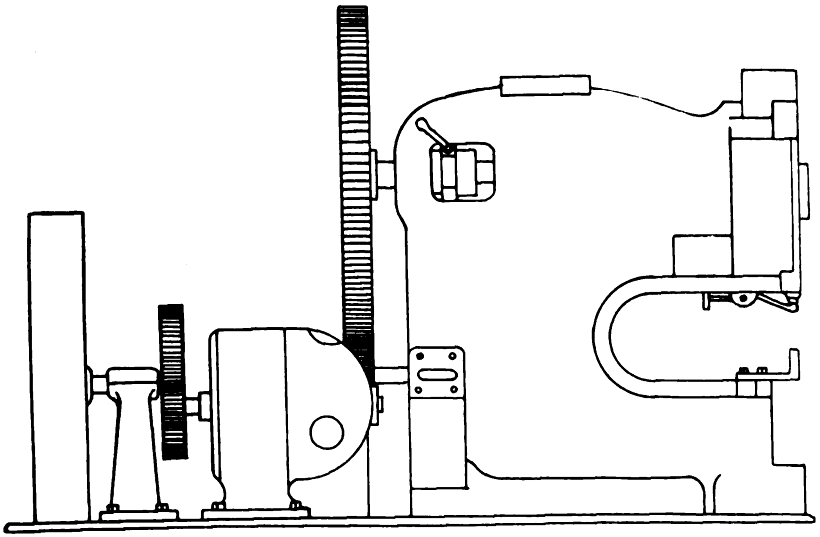


Fig. 4.

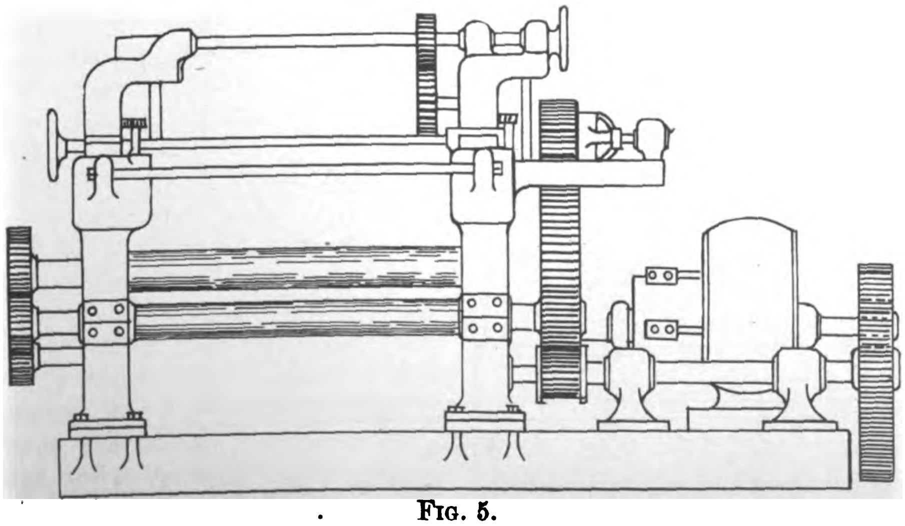


Fig. 5.

How much better it would be to locate a quiet running generator in that engine room, transmit power to a motor driven compressor, like Fig. 1 or Fig. 2, located right in the room where compressed air is wanted. A boiler shop in operation is always a noisy place, therefore the extra noise caused by this machine could do no harm. I have not heard of a case where this experiment has been tried and abandoned.

Punches are used in modern boiler shops and as a rule these can be driven by motors to good advantage. Fig. 3 illustrates one of these on which a large gear wheel revolving slowly, acts as a balance wheel with good effect. It will be noted that this balance wheel is directly on the main shaft of the machine, therefore when the punch strikes the metal to be worked, the momentum of this wheel carries it along without strain on the motor, or any other part of the mechanism except the main shaft

I have seen a belt-driven punch on which the belt was very slack, punch out an elliptical-shaped hand hole about 4 x 5 inches without tightening the belt, as the fly wheel did the whole of it.

Fig. 4 is another motor driven punch, but the design is quite different. There is a spurgear on the armature shaft at the left, which meshes into a larger gear on an independent shaft which also carries a fly-wheel on one end outside of the bearing, and a spur gear on the other which meshes into the large gear on the main shaft.

The effect of this in practice is to run the fly wheel at a high rate of speed, while the largest gear runs much slower, and as it is comparatively light, it gathers but little momentum. The strain of suddenly operating the punch is transmitted from the fly-wheel through the independent or auxiliary shaft, by means of two gears, but no strain is brought upon the armature shaft.

This line of argument and presentation of facts does not mean that the writer is an advocate of the idea that a fly wheel adds power to a machine, because it does not. Of course it gives out power when wanted in this and similar cases, but all that it furnishes (and more too) was put into it by the motor or engine that drives it, as the case may be, consequently it absorbs power that can never be reclaimed. We use such devices as a matter of convenience, and are contented to put more power into them than we take out, because it enables us to work to better advantage, making it a paying investment.

Fig. 5 is a set of boiler plate rolls driven by a motor. As these rolls always turn slowly but require considerable power at times, the motor travels at a high speed which is reduced first by heavy sprocket wheels and a silent chain at the right hand side, then by suitable gears shown between motor and rolls.

This certainly is in great contrast to the old-fashioned rolls turned by inserting long hand spikes in them, relics of which may still be seen around some of our old boiler shops. It is also superior to other means of driving rolls of this kind on account of the ease with which a plate may be handled, also because the apparatus may be located anywhere it is wanted without regard to location of shafting.

Small portable electric motors are used in boiler shops, competing with pneumatic tools, proving both convenient and economical.

After a man has used a petticoat lamp burning lard oil inside of a boiler until the air becomes saturated with smoke and vile odors, he appreciates a clean electric lamp and does better work accordingly.

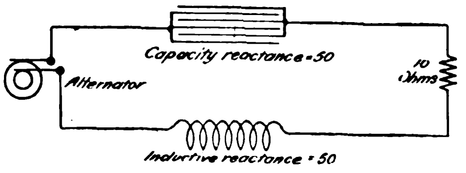
LIGHT, HEAT AND POWER PRINCIPLES.—VIII.

BY NEWTON HARRISON, E. E.

Resonance in Circuits.—By resonance in circuits is meant a condition in virtue of which neither the capacity or inductive reactance is individually operative. While both are present, yet neither appears except as a cause for a high internal electromotive force. The circuit in which both these influences exist then acts as though there were only resistance present. The condition is expressed by the statement that the impedance due to inductive and capacity reactance is zero. For instance, if the resistance of a circuit carrying an alternating current were 10 ohms, and the capacity and inductive reactance equal respectively to 50 apiece, then, according to the formula, the impedance equals the square root of $10^2 + (50 - 50)^2$ which equals 10. In this case the formula for impedance has been closely followed and values given to the indicated symbols. The formula is expressed as follows: Impedance =

$$\sqrt{R^2 + \left(p\ L - \frac{1}{pK}\right)^2}$$

in which R = ohms, $p = 2\pi f$ where f = frequency, L = inductance and K = capacity in farads. The fact that in the example given, p L was made equal to $1 \div p\ K$, means that the inductive and capacity resistance when made equal create a condition within the circuit the same as though only ohmic resistance were present. For this reason a circuit is in a resonant condition when the obliteration of each particular effect is complete enough to leave only room for the purely ohmic effect. When a circuit has a resistance of 10 ohms, and an inductive and capacity reactance respectively of 50 ohms equivalent, then the



Circuit in which capacity and inductive reactance are equal, making it resonant. Only resistance remains.

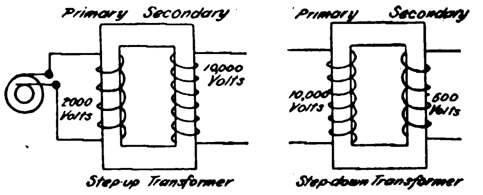
$$\sqrt{10^2 + (50-50)^2}$$

is evidently equal to only 10. But although only a 10 ohm resistance actually remains, the inductance within the coil is capable of developing a very high electromotive force. If, for instance, 100 volts are applied, then $100 \div 10 = 10$ amperes in the coil; but the reactance due to self-induction is 50, therefore the EMF. of inductance will equal $10 \times 50 = 500$ volts.

This represents the degree of reaction due to the inductance or inductive reactance multiplied by the current. The presentation of these facts is made for the purpose of showing how power and lighting circuits are affected by inductive and capacity reactances. To recapitulate, lead is caused by capacity operating in a circuit to a great enough extent to hurry the current forward; lag is caused by inductance operating in a circuit to a great enough extent to retard the progress of the current.

The technical form of expression given is that the capacity causes the current to lead the impressed EMF.; also that self-induction causes the current to lag behind the impressed EMF. The effect of the resistance itself is to cause both the current and EMF. to be in perfect phase with each other. In other words, if an electric circuit was not affected by capacity or inductance, if neither were present, the current would not lead or lag, but be in phase with the impressed EMF.

The Transformer.—Alternating currents are successfully handled in connection with electric light and power work by means of transformers or converters. There are two general classifications to be made of this particular form of apparatus. First, the ordinary type of transformer, by means of which an alternating current of high potential can be converted into one of low potential, or *vice versa*. Second, the class of machines, termed rotary converters, by means of which an alternating current can be transformed into a direct current, or *vice versa*. By means of both types of devices, alternating and direct current can be moulded to suit the wishes of the engineering experts intrusted with the design and development of any such propositions. It is needless to add that both the transformer and the rotary converter are closely associated together in the work of transmitting and distributing electricity for light and power purposes. The method of combining them is shown in the illustration, which shows how an alternating current is handled from the source of its generation to the point or points of distribution. The various processes involved may be noted in the following synopsis:



Transformers for raising and lowering voltage.

First—The hydraulic or mechanical energy obtained from water power or the burning of coal, oil or wood is utilized to produce rotation.

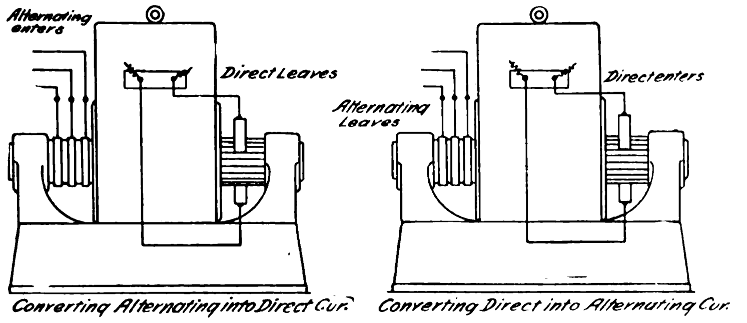
Second—The electrical generators are connected up for the purpose of transforming the mechanical energy of rotation into two or three phase alternating of a pressure varying from 500 to 2,000 volts or over, as the case may be.

Third—The alternating current thus generated is sent into one or more step-up transformers, whose function it is to raise the potential, without any considerable loss of energy, to an economic value for efficient transmission.

Fourth—The high tension alternating of from 5,000 to 6,000 volts is transmitted over the power lines to a point at which the first step toward distribution takes place in lowering the potential.

Fifth—The station or stations receiving the high tension alternating current convert it in one or more step-down transformers to a lower pressure while retaining a reasonably high efficiency in the process.

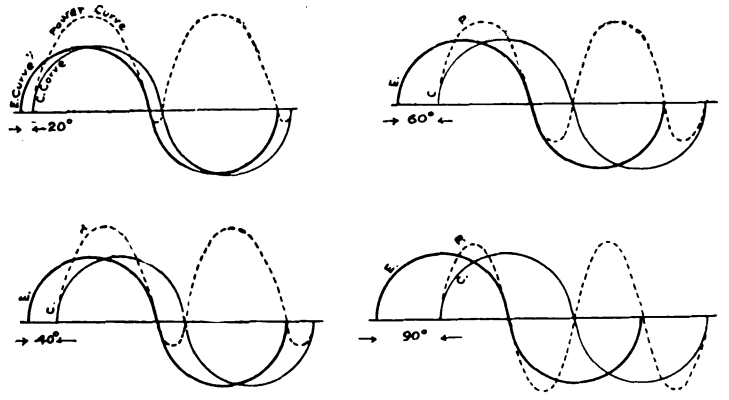
Sixth—The electricity is then transmitted to one or more rotary converters, which transform the alternating into a direct current ready for distribution. The low pressure alternating can be distributed at once for power and light purposes, but it is the usual practice, where trolley systems are to be operated, to convert the alternating into 500 or 600 volts direct. The forms of energy involved in this complicated process are as follows: First, medium pressure alternating; second, high pressure alternating; third, low pressure alternating; fourth, low pressure direct current. As each of these transformations involve the use of a device, whose efficient operation determines the power returned from the process, it is evident that the character of the process itself must be ultimately examined to grasp the limitations of the efficiency involved.


Alternating enters
Direct Leaves
Alternating Leaves
Direct enters
Converting Alternating into Direct Cur.
Converting Direct into Alternating Cur.

Rotary Converters.

Single Phase Current Power.—The amount of power produced by a single phase current is best known by reference to the power factor. The greater or less this is the greater or less the single phase power in the circuit. The plotting of the EMF. and current as two sine waves, with the difference of phase showing between them, does not convey in an adequate manner the amount of power involved. Calculations taking into consideration the power factor will do so, as, for instance, if the power factor is 80, 90 or 95, and the volts 100 and the amperes 10 or a product of 1,000, then with these power factors the total power in each case would be 800, 900 and 950 watts respectively. But this condition can be represented by means of a curve, showing the conjunctive action of the EMF. and current in each and every case of this character arising.

Power Curves.—What are called power curves are simply illustrations of the principle, simple in itself, of multiplying together the volts and amperes of power to obtain a new curve embodying this product. The sine wave of the volts consists of a curve due to a variety of values of EMF. Each point on the curve is represented by a vertical line called the ordinate. The termination of this line is the point of the curve, and an immense number of values between one zero and another gives the curve itself. The volts are therefore an instance of a rise of EMF. from zero to a maximum called the amplitude, and a comparatively gradual drop to zero again. The same is true of the curve of the current. It has its two zero values where it begins and ends, and its amplitude as well. If the two ordinates at any given point, or at all points of the curves, are multiplied together, it is evident that where only one ordinate is found, and the other is missing, there is no power. The same is true where the zero points are found on both curves. The fact must also be considered that the power curve thus drawn will be partly above and partly below the locus or zero line. The only exception will be found when there is no difference of phase between the EMF. and current.

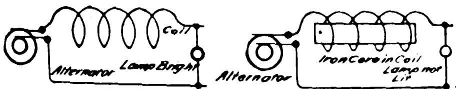


Power curves more below the zero line as the angle of lag increases, until at 90 degs. curves above and below are equal.

This condition will be considered in connection with those cases arising where the phase difference exists. Examination of the curves of EMF. and current, showing a lag of the current behind the EMF., indicates a series of zero values for both the EMF. and current. The first zero value is found where the EMF. begins. The second zero value is found where the current curve begins. The third zero value is found where the EMF. curve ends preparatory to the beginning of a new curve on the under side of the zero line. The fourth zero is found where the current curve crosses the zero line after becoming zero, and about to begin a new curve on the under side of the zero line. The fifth zero is found where the EMF. curve on the under side of the zero line returns to the zero line, and to zero. The sixth zero is found where the current curve on the underside of the zero line returns again to the zero line and to zero. The six zero points will always appear when there is a lag between the EMF. and current. They are significant because they represent the six zero points of the power curve constructed by multiplying the EMF. and current ordinates together. Wherever a zero point appears it is evident there can be no power, however large the ordinates of the other element of power. For this reason the curve of power will rise above the zero line where there are only positive ordinates to be multiplied together, and it will fall below the zero line wherever there are positive and negative ordinates to be multiplied together. But it must be remembered, that it will also rise above the zero line whenever *negative* elements are multiplied by *negative* elements. The zero line, it may be known, with reference to this state of affairs, indicates also the difference between the power consumed and the power returned. For instance, the extent to which the power line dips below the zero line, is a measure of the amount of negative power or power returned to the generators. The extent to which the power line appears above the zero line, is a measure of the amount of positive or available power that is or can be utilized. When the ordinates of the EMF. and current are therefore multiplied together, the power curve will be found to rise above the zero line and fall below it, rise above the zero line and fall below it, forming a curve of four amplitudes when lag exists. As the lag increases or diminishes, the power curve appears more below the line or above it. With great lag it is more below the line. With less lag it is more above the line. When the lag equals 90 degs., it is as much above the line as below it. In other words, there is as much power returned to the generator as it sends out. Illustration of these cases are given for the purpose of showing the ebb and flow of the energy, both when such ebb and flow is useful and when it is useless.

When the Power Factor is Zero.—When the power factor is zero, it means that the angle of lag equals 90 degs. between the current and EMF. In this case, the cosine of this angle equals zero, and the multiplication of the current and EMF. elements, however large, when again multiplied by the power factor zero would give only zero. But this does not mean an absence of electrical energy in the circuit; its elements are there but not in an available form. Therefore the false power pulsates in and out of the circuit without accomplishing anything. The fact that the power wave is equal above and below the line clearly indicates this pumping out and withdrawal of the electrical energy from the generator into the circuit and back again. An alternator producing a current with a 90 deg. lag is therefore only consuming enough energy to run as an idle machine. Friction and certain iron losses are the only ones met with. To make it consume more power it must establish a current in a circuit in which the lag is less than 90 degs.

Examples of Lag.—Practical examples of lag may be given and illustrated, to show the ideas contained in this exposition of its meaning with respect to the total power. One or more incandescent lamps may be connected in multiple, with a coil inserted in one leg of the line. The current is alternating, and the coil of such a low resistance, that the candle power of the lamp is not affected. The coil must be so wound that it will receive a core of divided iron of a high quality. The following series of experiments may then be tried: First, the lamp and coil in series will cause no change in the candle power of the lamp. Second, a core of iron inserted a very short distance within the coil will cause a perceptible lowering of the candle power of the lamp. Third, the insertion of the core about one-third or one-half the distance, will cause the lamp to drop in candle power to a bright red. Fourth, the total insertion of the core will serve to put the lamp practically out. The explanation given is two-fold and as follows: The coil in the first place has very little inductance reactance, because the effects of self-inductance are not very marked. The permeability μ is only equal to 1, and the inductance in consequence limited. But with the introduction of an iron core the number of lines of force increase, the self-induction increases, and the lag and impedance also increase. This is made manifest by the drop in candle power to a point where no light appears, because the energy has been almost entirely choked. This idea is of great value in forming a proper estimate of the reactions occurring in the primary and secondary coils of a transformer.



Effect of inductance of the light of a lamp.

The regulation effected by which a uniform candle power is preserved in the lighting circuits, depends upon the crystallization of such principles.

TURBINES VS. RECIPROCATING ENGINES.*

BY DECAPOD.

As turbines are now becoming close running rivals with reciprocating engines for different classes of work, chiefly electric generator driving and ship propulsion, a valuable criticism on the operation of the two methods of obtaining the most efficient and reliable prime mover may be raised.

In the case of the reciprocating engine, its operation is so well known that little can be said to enable it to be understood better than it is at present; it has almost reached the peak of its efficiency and reliability of operation for long runs under the worst conditions, such as driving a generator for heavy railway traction or shipwork in a heavy sea. Limits of steam pressure and temperature are low—450 degs. F. for steam temperature is as high as can be considered safe for keeping good smooth rubbing surfaces, such as valves, pistons and rods; higher temperatures necessitating expensive lubricating oils and a certain amount of uneasiness on the part of the man in charge if the engine is running with fine clearances. Then if surface condensers are used, there is always the trouble of extracting the oil from the hot-well before water can be used again for boiler feed. With triple-expansion engines it has been proved that a 26 inch vacuum gives the best results, and further, there is a limit to the expansion carried out in the low-pressure cylinder, due to the condensation and re-evaporation of steam on the cylinder walls, etc. The advantages of reciprocating engines over turbines for shipwork is in the manœuvring, the small size of propellers necessary for the high speed of turbines making it more difficult, especially from rest in narrow waters.

Trials have been made which show that turbine steamers going full speed ahead can be brought to rest in about a minute and a half. This is a good result, but actual experience has shown the relative inadequacy of going astern from rest. The case of the turbine is a most favorable one especially for central stations, it being an ideal drive for alternating-current generators in parallel on account of its equal turning movement. The turbine being a purely rotary motion with no rubbing surfaces, high pressure and temperature steam can be used with its full advantages, the only thing being slightly increased peripheral blade clearances for extra high superheat. The steam consumption of a turbine can be improved by 10 per cent. for 100 degs. F. of superheat with steam at 160 lbs. square inch. Then, again, it pays to have the best vacuum possible, and the steam can be expanded to its utmost limit. The gain from an increased vacuum is so great that it is advisable to pay great attention to the design and upkeep of the condensing plant. For shipwork it is sometimes usual to fit a vacuum augmenter, by which means it is possible to maintain a vacuum of 28½ inches in the condenser. Another good feature of the turbine is that it requires no lubricant mixed with the steam, therefore obviating the necessity of any oil extraction from hot-well water. In large turbines for central stations it is usual to have the bearings lubricated by the oil gravity system—that is, with a tank some 40 feet above the engine-room floor level, into which the oil is pumped from another tank below the engine-room floor level, the oil running from top tank through the bearing and into the lower tank to be filtered and cooled, then pumped up to the top tank to be used over again. Oil treated in this way will last for months, care being taken to keep water out of the oil, as it sometimes leaks through from the water-jacket on large bearings, on account of leaky castings.

As in all engines, the governor is a very important consideration; a fly-ball type of governor is made use of. The speed of the turbine can be varied within all the limits of the governor spring whilst the turbine is running. This is particularly useful for bringing alternators into synchronism and adjusting their differences of load when in multiple. There being no variation of angular velocity in the turbine, which is necessarily present in reciprocating engines, heavy synchronizing currents between two alternators in parallel are avoided. All power being transmitted rotatively, foundations are cheaper than for the same output in reciprocating engines.

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*From the "Electrical Engineer," London.

Many people imagine that the blades wear under the action of steam, but experience shows that with superheated steam this is not so. In the case of where steam is admitted through nozzles, slight wear is noticeable in the nozzles, owing to the tremendous velocity of the steam. If there is any water in the steam, this wear is increased tenfold. The bearings of a turbine require to be run with very fine clearances, .008 inch being usual with forced lubrication. Very fine centering of the spindle in cylinder is necessary, as the peripheral blade clearances in sizes up to 500 hp. are usually only .02 inch with 100 degs. F. superheat; with sizes of 7,000 hp., with the same superheat, .08 inch clearances are necessary. The spindle should always be in perfect running balance on account of the fine peripheral blade clearances.

The usual method of balancing heavy spindles is to lay them on knife-edges, gravity causing the heavy parts to come to the bottom. This method usually suffices, but no degree of real accuracy can be attained, as one cannot tell for certain which end requires the additional weight to bring it into balance. With smaller sizes it can be run up to speed and marked with a colored pencil at different points, which shows where to add additional weight. A small body revolving at 5,000 r.p.m., the light side is always the one that comes out, so that weight should be added where the marks are. In some cases the marks are different at each end, when weight needs to be added at each end to suit.

For slower speeds than 5,000 r.p.m. the marks usually come at certain angles, leading the light side this can easily be found by trials. As there are so few moving parts in a turbine compared to the numerous moving parts in a reciprocating engine, the repairs and replacements are small in comparison.

Greater economy in oil and attention is on the side of the turbine, as they run cleaner, and all that has to be done is to turn on the steam and keep an eye on the oil to bearings. The chances of breakdowns on both the reciprocator and the turbine are probably equal, and the most serious break down for a turbine is the wearing down of the balance pistons through allowing them to come in contact with the cylinder casing. As the rings of these pistons are solid with the main spindle, it means turning off the whole of the piston and shrinking on a new one. This is a long job, and means throwing the turbine out of service for at least four weeks. Another serious breakdown is likely to happen from loss of oil to bearings. Such accidents have happened, causing bearings to seize and put such a strain on the spindle as to bend it. Once bent it is difficult to get it back to its original position and seldom to make it run as true as before accident. A strip in the blades is for shore work usually a stoppage of about five days in small sizes, and repairs can be effected on sight with ease, the reblading not being as difficult as it would appear to be.

With good tools and men used to the work, it is surprising how soon a few thousand blades can be fixed in position. There is usually no sign indicated previous to a strip, and the first thing noticeable is a sudden grinding, then a full stop, the blades shearing off close to the main body of the spindle and becoming wedged between the spindle and the cylinder casing, no damage being done to any other part beyond the actual blades. The usual cause of strips may be put down to too fine clearances with excessive superheat, spindle being out of balance, and shaft whipping causing blades to rub, a heavy dose of water from boilers while on load, or a weak blade breaking off and fouling. A strip does not mean the whole of the blades, and may be anything from two rows to twenty. These three breakdowns are the only ones that can happen of any serious moment, and with the ordinary amount of care and intelligence it can be proved that the turbine is becoming as reliable as the best reciprocating engine.

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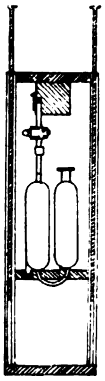
WRINKLES.*

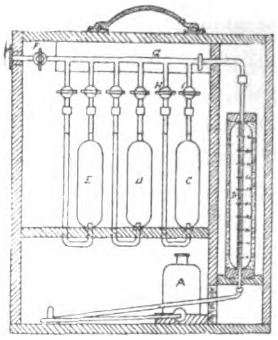
EDITED BY H. C. ABELL.

An Apparatus for the Rapid Analysis of Flue Gases.

The analysis of flue gases as ordinarily conducted with the D'Orsat or Hempel apparatus requires considerable time, if accurate results are to be obtained, so the apparatus presented here was designed to enable analyses to be made more quickly. The essential feature is the introduction of the gas in the re-agents in a finely divided stream at the bottom of the absorption pipettes, so that it bubbles through the liquid and consequently comes immediately into intimate contact with it.

A is the leveling bulb; B is the measuring tube which is water-jacketed; C is the first absorption pipette, in which caustic potash is used to absorb carbon dioxide; D is the second absorption pipette, in which potassium pyrogallate is used to absorb oxygen, and E is the third pipette, in which cuprous chloride is used to absorb carbon monoxide; F is the inlet cock; G is the header; H is the inlet cock to one of the absorption pipettes, and I is the outlet cock to one of the absorption pipettes.





The method of analysis is as follows: A sample of gas is drawn in through the cock F, along the header G to the measuring tube B by lowering the leveling tube A. A little more than 100 cubic centimeters are taken in. The leveling tube A is then raised so that the water in it is even with the zero mark on the measuring tube B, and the cock F is open for an instant, so that the gas in the tube B comes to atmospheric pressure. The cock F is then closed, and the tube B contains 100 cubic centimeters of gas at atmospheric pressure. Cock I is then opened, and the bulb A is slightly raised, so that about three cubic centimeters of gas is transferred to the pipette C. This is done to clear the capillary tube at the top of C of the re-agent, The cock I is then closed and the cock H is opened and the rest of the gas bubbled in through it at the bottom of the pipette. When the gas is all in the re-agent is drawn back into the capillary leading from the bottom of C to H, and the cock H is closed. The cock I is now opened, and the gas is drawn back through it into B by lowering A. The cock I is then closed and the gas in B measured in the usual way. This operation is repeated in the pipette C until there is no further absorption. The gas is then transferred to D and E and the same process repeated.

If care is taken at the close of each analysis to see that the cocks are greased with vaseline, there will be no trouble from the tendency to stick, which has been frequently advanced against the use of glass cocks in gas-analysis apparatus.

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*Paper presented before the National Electric Light Association at its 28th convention. held at Denver-Colorado Springs, Col., June 6-11 1905.

W. B. TUTTLE, Long Branch, N. J.

Canvassing Gas and Electric Light Companies.

A report from Albany, N. Y., Monday, says the Commission of Gas and Electricity is engaged in making a canvass of the gas and electric light and power companies of New York State and each company, municipality and individual engaged in the business of furnishing gas or electricity for lighting or power purposes is asked to give certain details of stock and bond issues, amount invested in the plant and capacity and price charged for public and private lighting and power purposes. About 150 reports have been received, including reports of the New York City Edison Company and all the Brooklyn companies.

Jersey City-Newark Tunnel to be Built.

An underground railway, 8½ miles long, and tunneling the Passaic River, is to be constructed from Jersey City to Newark, in place of a mile and a-half spur of the Hudson & Manhattan Railway, to have been built in Jersey City. A certificate abandoning the proposed spur, and setting forth the intention of constructing the underground road has been filed with New Jersey's Secretary of State, and $16,800 deposited as an evidence of good faith.

The proposed branch will start in Jersey City on the Pennsylvania Railroad property, pass through Kearney and Harrison, and after entering Newark, will follow that part of Railroad avenue south of the viaduct of the Pennsylvania Railroad.

From Steam to Electricity.

The Pennsylvania Railroad Company has decided to go ahead with the plan to equip with electric power the old West Jersey & Seashore Railroad to Atlantic City, and some of the suburban lines out of Camden.

This was announced Monday in Philadelphia by Samuel Rea, third vice-president of the company, and chairman of the special committee having the matter in charge. He said it would take a year to complete the work.

N. E. L. A. Proceedings.

It is expected that the book of "Proceedings" of the 28th convention of the National Electric Light Association, held at Denver and Colorado Springs, will be ready for distribution about November 20. The papers, reports and discussions presented at the conventions of this association are now so voluminous, they can no longer be bound in one volume, and, following last year's precedent, this book will be issued in two volumes, Vol. II containing the Question Box and Wrinkles, which alone comprise over 700 pages.

Chicago's Electrical Show.

Chicago is fast getting everything into shape for its first annual electrical show, which is to be held at the Coliseum from January 15 to January 26. Thomas R. Mercein is general manager, with offices in the Monadnock Building. In the Coliseum there are 38,000 square feet available for exposition purposes.

Lectures at the University of Minnesota.

Mr. E. P. Burch, consulting electrical engineer, is giving a course of lectures on "Heavy Electrical Railroad Work," at the University of Minnesota. The subjects of the individual lectures are "The Physical and Financial Advantages of Electric Traction for Heavy Railway Work," "The Speed-Torque Characteristics of Steam Locomotives," "The Speed-Torque Characteristics of "Electric Locomotives," and the "The Physical Data for the Electrical Equipment for Operating a Division of a Trans-Continental Railway."

These lectures are based upon the investigations made by Mr. Burch for some of the Western railway companies, which are investigating the feasibility and desirability of electric traction upon certain divisions on their main lines.

Subscription Agents Wanted.

There is a splendid offer made to agents by "The Four-Track News," one of the most popular magazines in the country and one of the very best sellers. Subscription agents are wanted everywhere and large profits are assured. It will pay you to write to George H. Daniels, publisher, 7 East 42d street, New York, for full particulars.

Mr. Robert McF. Doble, consulting engineer of San Francisco, Cal., has severed his connection with the Abner Doble Company in order to resume his individual practice.

ELECTRICAL PATENT RECORD

LETTERS PATENT ISSUED NOV 7, 1905.

Electric Railways and Appliances.

803,539-540. Block-Signal System. Charles E. Bennett, New York City. Filed June 10 and July 11, 1905.

803,793. Insulated Rail-Joint. Reuben W. Smith, Bryn Mawr, Pa. Filed May 26, 1905.

803,806. Trolley-Wheel. Emile Brossy, West Hoboken, N. J. Filed July 20, 1904.

804,126. Railway Switching and Signaling Apparatus. Winthrop K. Howe, Buffalo, N. Y., assignor to the Taylor Signal Company, same place. Filed March 28, 1903.

804,176. System of Automatic Signaling for Electric Railways. Fitzhugh Townsend, New York City, assignor to the General Railway Signal Company. Filed Aug. 1, 1905.

Electric Lights and Appliances.

803,819. Bracket-Arm for Incandescent Electric Lamps. Hiram L. Getz, Marshalltown, Ia. Filed May 17, 1904.

Electrical Machinery and Apparatus.

803,811. Power-Transmission Device. George A. Cutter, Nashua, N. H. Filed Aug. 14, 1903.

803,825. Trip-Coil for Circuit-Breakers. John D. Hilliard, Jr., Schenectady, N. Y., assignor to the General Electric Company. Filed Feb. 13, 1902.

803,834. Control System. Carl W. Larson, Schenectady, N. Y., assignor to the General Electric Company. Filed April 17, 1905.

803,845. Transmission-Gearing. Charles E. Neal, New York City. Filed March 30, 1905.

803,853. Brush-Holder. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company. Filed March 26, 1904.

803,898. Electric Switch. Arthur E. Handy, Providence, R. I., assignor to the Rhode Island Elevator & Machine Company. Filed Oct. 20, 1904.

804,045. Electric Welding Clamping Device. Adolph F. Rietzel, Lynn, Mass., assignor to the Thomson Electric Welding Company. Filed Nov. 16, 1903.

804,070. Electrical Fuse-Plug. George B. Thomas, Bridgeport, Conn., assignor to the Bryant Electric Company. Filed May 22, 1905.

804,156. System of Electric-Motor Control. Charles A. Mudge, New York City. Filed March 2, 1905.

Telephones and Telephone Apparatus

803,676. Telephony. Francis W. Dunbar, Chicago, Ill. Filed Nov. 12, 1904.

803,856. Telephone System. William A. Robinson, South Kortright, N. Y. Filed Feb. 18, 1904.

803,890. Telephone Night-Watch System. William Geckler, Rochester, N. Y. Filed Oct. 17, 1904.

803,980. Telephone-Holder. Charles H. Borden, Stamford, Conn. Filen March 1, 1905.

804,077. Telephone-Exchange System. Harry G. Webster, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed May 7, 1903.

804,103. Telephone Switchboard Apparatus. Thomas V. Davis, Kansas City, Mo., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed April 4, 1904.

Miscellaneous.

803,544. Apparatus for Refining Lead by Electrolysis. Anson G. Betts, Troy, N. Y. Filed March 18, 1904.

803,569. Induction Transformer for Wireless-Telegraphy Receiving-Stations. Eugene Ducretet, Paris, France. Filed March 2, 1904.

803,684. Instrument for Converting Alternating Electric Currents into Continuous Currents. John A. Fleming, London, Eng., assignor to the Marconi Wireless Telegraph Company of America. Filed April 19, 1905.

803,795. Electric Heating Device. George E. Stevens, Lynn, Mass., assignor to the General Electric Company. Filed Feb. 15, 1904.

803,816. Insulating Material. William L. R. Emmet, Schenectady, N. Y., assignor to the General Electric Company. Filed Nov. 24, 1900.

803,836. Vapor Electric Apparatus. Alexander D. Lunt, Schenectady, N. Y., assignor to the General Electric Company. Filed May 12, 1904.

803,936. Electric Pump. John C. Stokes, Mansfield, La. Filed Feb. 28, 1905.

803,973. Insulator. George M. Bemis, Readsboro, Vt. Filed June 11, 1904.

804,040. Electrically-Operated Door-Opening System. William T. Platt, St. Louis, Mo. Filed March 7, 1904.

804,114. Electrical Rosette. Gilbert W. Goodridge, Bridgeport, Conn., assignor to the Bryant Electric Company, same place. Filed Nov. 21, 1904.

804,115. Electrical Insulator. Gilbert W. Goodridge, Bridgeport, Conn. Filed May 5, 1905.

804,182. Metallic Circuit for Operating Signaling Devices. Albert K. Andriano and Hermann Herbstritt, San Francisco, Cal. Filed March 6, 1905.

804,189-190. Apparatus for Measuring the Length of Electric Waves and Instrument for Making Electrical Measurements. John A. Fleming, London, Eng., assignor to the Marconi Wireless Telegraph Company, Limited, same place. Filed Feb. 8, 1905.

THE TELEPHONE WORLD.

Victory for Independents.

Uniontown, Pa., capitalists, headed by J. V. Thompson, have purchased the property and rights of the Carmicheals Telephone Company at Carmichaels and Jefferson, Greene County. The acquisition is counted on as a big victory for Independent concerns in that section, owing to the fact that the Bell Company succeeded recently in purchasing the property and rights of the South Bend Telephone & Telegraph Company.

Aside from obtaining the exchanges the company by the contract comes into possession of the franchise for an exchange at Waynesburg, which was granted in 1897. The Carmichaels Company had toll lines to Masontown, Fayette County, and within one mile of Waynesburg. The loop will be completed and the exchange at Waynesburg will be built at once.

The new company will affiliate itself with the Pittsburg & Allegheny of Pittsburg, the Tri-State Company of Uniontown and the National Company.

The Pacific Telegraph & Telephone Company of Oakland, Cal., has been granted permission by the board of public works for a period of 30 days to trim trees within the city limits where such are in contact with wires already in place, or where new wires are to be placed, on the condition that the trimming should be done by an expert to be approved by Head Gardner Lamond, and be trimmed to the entire satisfaction of the head gardener.

The certificate of incorporation of the East Concord, N. Y., Telephone Company has been filed in the office of the county clerk. The company is capitalized at $5,000. It will run a line through Concord, Sardinia and Colden. J. L. Smith, Samuel D. Vance, Ward H. Marse and Fred T. May of East Concord, George J. Domes and A. E. Spencer, of Sardinia and L. A. Vaughn of Concord, are the directors.

Recent news from Terre Haute. Ind., states that the Citizen's Telephone Company has ordered plans and is now asking for bids for the construction of a modern exchange building. The controlling interest of the company has been secured by the Kinloch people of St. Louis, and the new management anneunces that many improvements will be made.

The South Porto Rico Telephone Company has been incorporated in Portland Me., to build and operate telephone lines. Its capital stock is $30,000. The officers are: President, B. L. Cram; treasurer, A. F. Pike; clerk, C. D. Booth, all of Portland.

The Texas & New Mexico Telephone Company of Las Cruces, N. M., capitalized at $15,000, has been granted a permit to do business in Texas, with its principal office in El Paso.

The Harrison County Telephone Company of Cadiz, O., has increased its capital from $50,000 to $100,000.

Telephone statistics show that almost 20,00,000 persons use the telephone daily.

New Exchange to be Erected.

The Independent Union Telephone Company of Albany, N. Y., will erect a two-story long-distance exchange in Howard street within the next month or so. The work has already been arranged for. Ground will be broken for the new building at once, and the structure will be rushed to completion. It will cost $15,000.

The increased demands upon the long-distance service of the Home Telephone Company made it necessary that additional room be supplied to its office force and to that end it was thought wise to erect a separate building where the long-distance service would be exclusively cared for.

Try to Prevent Telephone Deal.

The hearing on the application in the Wayne Circuit Court for a permanent restraining order to prevent the sale of the Independent Co-operative Telephone Company to the New Home Telephone Company, organized by St. Louis capitalists to develop the Detroit, Mich., Independent field, has been put over until November 20, Judge Mandell having issued a temporary restraining order.

Work will be started at once on the telephone conduits in Chattanooga, Tenn., which will be constructed along certain streets of that city. The contract for the entire job has been let to G. M. Gest, of New York. It is the expectation that the work will be completed by January 1, when all lines and cables on streets traversed by conduits will be placed underground.

The petition of the Atlanta, Ga., Telephone & Telegraph Company for the right to place beneath various streets underground conduits was lately approved by council's committee on electric lights. The conduits, however, can only be used for telephone and telegraph purposes exclusively, except on such terms and conditions as the general council may hereafter impose on petitions therefor.

The delay in the work of remodeling the Athens, Ga., telephone exchange, has been caused by the delay in the shipment of the cables that are to be used in the new system. They were promised by the manufacturers last August, but they have not yet been delivered.

The Bell Telephone Company of Philadelphia, Pa., and the American Telegraph & Telephone Company of New York City, are placing 75,000 miles of wire underground between Wilmington and New York.

The Gate City, Va., Telephone Company has the following officers: President, O. H. Gobble, Clinchport; vice-president, W. D. Smith; secretary and treasurer, J. M. Minnich, of Gate City. The capital stock is $5,000.

In Gouverneur, N. Y., the proposition to issue $25,000 bonds for a municipal telephone system will be submitted to a vote.

Telephone Bids Wanted.

Sealed proposals will be received at the office of the engineer, United States Reclamation Service, Billings, Mont., until December 15, for installing a telephone system having eight or more telephone stations and 22 miles or more of pole line. Particulars may be obtained by application to the Chief Engineer of the Reclamation Service, United States Geological Survey, Washington, D. C., or to Robert S. Stockton engineer, Huntley, Mont.

Bids are being received by the Independent Telephone Company of Council Bluffs, Ia., for the erection of a new exchange building.

Since the Lewiston, Me., board of mayor and aldermen refused to grant the New England Telephone & Telegraph Company's petition for certain rights and privileges in regard to constructing telephone lines within the city limits, there has been considerable talk from time to time ard more than one inquiry has been made by Lewiston taxpayers to know just what the city is getting in return for the franchise and liberties that the New England Telephone Company is enjoying in Lewiston.

O. L. Barger is at the head of a telephone company that has petitioned the Marion, Ind., council for a telephone franchise. The petitioners state that, if granted, an automatic telephone system will be established. The company proposes a service rate not to exceed $1.75 a month for residence telephones and $2.75 for business telephones.

The Attalla, Ala., city council at a recent meeting refused by a unanimous vote to grant the Independent Telephone Company a franchise. It was claimed that the present company was giving a good service and that two companies would increase the expense to the people.

News from Stamford, Conn., states that the Southern New England Telephone Company has purchased a lot of land in Gray Rock Place and will begin immediately the erection of a building for a new local exchange. A switchboard for 3,000 instruments will be installed in place of the present 600-instrument board The building will be completed next spring.

The new switchboard for the Telephone Exchange has arrived in Galveston, Tex., and work on its installation is expected to begin soon. It is thought that it will require some eight weeks to complete the work of installation. Mr. Chambers states that he hopes to have the new system in working order by the beginning of the new year.

The Winnebago County, Ill., Telephone Company has completed the rebuilding of its line in Rockford. The wires have been placed on taller poles, cables have been put in to do away with some of the single wires and all the latest improvements have been made.

The Walker Telephone Company of Shamrock, Tex., capitalized at $10,000, has been incorporated by J. E. Walker, Barnett Blossom and Rea Blossom.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Baldwin, Kan.—The proposition to issue $10,000 in bonds for a municipal electric light plant and also $2,500 for a city hall was lately carried. A maximum meter rate of 12 cents per 1,000 will be adopted.

Benton, Pa.—Definite steps have at last been taken towards bringing the Benton electric light plant into reality. The company has engaged W. O. De Witt, of this town, as consulting engineer, and he will at once prepare plans and specifications for the erection of the power house.

Broken Bow, Neb.—The much longed for electric light plant seems to be assuming a somewhat definite shape.

Cape May, N. J.—The Cape May Light & Power Company is prepared to extend its electric lighting system to Rio Grande, seven miles above here, supplying light to Lower Township and all villages along the road.

Cannon Falls, Minn.—A deal has been completed by which the Cannon River Electric Power Company of this place has become the owner of the Northfield Light, Heat & Power Company. The plant of Northfield will be managed by its present owners for a year, when it will pass into possession of the purchasers. Power for the plant at Northfield and also the local plant will eventually be transmitted from the dam to be built across the Cannon River, one mile west of the Falls.

Clinton, Miss.—This town contemplates issuing $2,000 of bonds for extending the waterworks and electric light plant. H. C. Joyner, mayor.

Courtland, Ala.—Lawson, Sykes & Co. want prices on machinery and equipment for an electric light plant.

Davis, I. T.—J. B. Dickinson will erect an electric light plant here.

Dayton, Tenn.—C. F. Dowker, of Grandview, has purchased of Thomas E. Stone the city electric light plant and is now in charge,

Frankton, Ind.—The water and electric light plant here will go into the hands of a receiver as soon as one is appointed and qualifies.

Joplin, Mo.—There is promise of increased electric lights for the streets of this city in the near future.

Kinsley, Mich.—George Raff, Jr., has the contract for installing the electric lighting plant in this city.

Kutztown, Pa.—The Keystone Electric Light, Heat & Power Company has reduced its rates of lighting private and business houses, from 10 to 7, and probably 6 cents per thousand kilowatts. This change was created through the competition of the borough electric plants.

Lexington. Ky.—Architect Richards, of Columbus, O., has submitted plans and specifications for an electric lighting and power plant, which is designed to furnish light and power for the entire block bounded by Mill, Upper Main and Water streets.

Little Rock, Ark.—A waterworks and electric light plant will be constructed at North Little Rock. Address C. J. Humphreys, 104 East 4th street, waterworks commissioner.

Wallingford, Conn.—The electrical commissioners are in receipt of a communication from representative citizens of Yalesville in reference to holding a meeting relating to the introduction of electricity from the borough's municipal plant for the lighting of the streets of Yalesville.

STREET RAILWAYS.

Asbury Park, N. J.—The property, franchises, etc., of the Atlantic Coast Electric Railway Company, which system extends from Pleasure Bay to Sea Girt, were lately sold in foreclosure proceedings. The purchaser was Adrian H. Joline, of the law firm of Butler, Notman & Joline, New York, and the price $700,000.

Bozeman, Mont.—There is good ground for believing that the project for an electric road for the Gallatin Valley is at last under consideration.

Cairo, Ill.—The Kentucky & Ohio River Interurban Railroad Company has increased its capital from $25,000 to $250,000. The company proposes to build an electric interurban line from this city to Paducah.

Clarksville, Tenn.—There is a probability of an electric line being built between this city and Hopkinsville, Ky.

Columbus, O.—The Elkins-Widener Syndicate is said to be negotiating for the purchase of the electric line now building between Zanesville and New Philadelphia.

Danbury, Conn.—It is understood that plans are under way to build a trolley line from Woodbury to this city, running through Sandy Hook, Newtown and Bethel, and at the latter place connecting with the Danbury & Bethel trolley road.

Easton, Pa.—The trolley line between this city and Washington, N. J., is now assured. For further information address T. Hay, president of the company.

Elizabeth, N. J.—A meeting of a number of local capitalists was lately held and the first steps taken toward the formation of a new trolley building company.

Hot Springs, S. D.—Congressman Eben W. Martin is working for a 12 mile trolley line and a lighting plant to be owned by the United States Government.

Indianapolis, Ind.—The Chicago, Kankakee & Lafayette Southwestern Traction Company has been incorporated with a capital of $100,000. The proposed new road is to run from Lafayette, Ind., to Kankakee, Ill.

Portland, O.—Philadelphia and local capitalists have formed plans for an electric line from this city to Salem.

Pottsville, Pa.—The council has granted the Pottsville Union Traction Company a franchise to build a trolley road here. The system will extend from Shenandoah through Frackville and St. Clair to this place.

Rochester, N. Y.—The Buffalo Pole Line & Constructing Company began the preliminary work of electrifying the West Shore Railroad between this city and Syracuse last week. The work involves an expenditure of about $550,000, and must be finished, according to contract, March 1 next.

Salina, Kan.—A trolley line for this city has been advocated by Mr. Burkholder.

Spencerport, N. Y.—Work is now being pushed on the electric road in this city.

Toledo, O.—The Gardner Construction Company, which has the contract to build the Toledo & Cincinnati Electric Line, will also erect the stations en route and other buildings as may be needed, including power plants and the like. The company, however, will not consider plans for several months yet, as it has but just began on the construction of the railroad.

Waterville, N. Y.—A meeting of the village board of trustees was lately held for the purpose of considering the application of Messrs. McBride and McAdam for a franchise on behalf of a proposed company to be formed for the building, equipping and operating of a trolley road over Mill street.

POWER PLANTS.

Los Angeles, Cal.—The Kern-Rand Company, a corporation recently formed under the laws of Arizona, and having offices in this city, is planning the erection of a power house on the south fork of the Kern River, and the construction of an electrical transmission line to Randsburg. J. W. Eddy is vice-president and general manager.

Milwaukee, Wis.—Architect C. F. Ringer has drawn plans for an electric power plant to cost $6,000.

Owingsville, Ky.—According to reports received here a syndicate of Eastern capitalists is preparing to install a big electric light plant at Rockcastle Falls, in the Rockcastle County Mountains, expecting thereby to furnish light and power for that section of the State. The intention is to harness the falls and save the power that is being wasted.

Utica, N. Y.—The Hudson River Electric Company is now engaged in the erection of a transmission line from its sub-station at Ballston to this city which will probably cost in the neighborhood of $250,000 and extend a distance of about 125 miles.

BIDS WANTED.

New York City.—The War Department, through the depot quartermaster here, is inviting sealed proposals until November 20, for furnishing 55,000 incandescent electric lamps. Proposed blanks and detailed information will be furnished upon application to Major Bingham, Army Building, 39 Whitehall street, New York City.

Washington, D. C.—The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until November 28, for furnishing Eastern Navy Yards with the following electrical supplies: Schedule 224, arc lamps, wire conduit, panel boards, electric clock, electrical supplies; schedule 225, micanite; schedule 227, motor, electrically driven grinders and drills. Blank proposals and full information can be obtained at the Navy Pay Office in New York or upon application to the Bureau in this city.—On December 12 the Bureau will open bids for furnishing Western Navy Yards with the following: Schedule 230, arc lamps, electrical supplies; schedule 231, storage battery outfit, generating set, transformer; schedule 233, motor. Blank proposals can be obtained upon application to the Bureau in this city.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 16⅜@16½c.; Lake 16⅜@16⅝c.; casting, 16⅛@16⅜c.

It is announced that a meeting of the directors of the Chicago Subway Company will be held in Jersey City this week.

It is estimated that shipments of steam turbines for the present year will aggregate about 330,000 kw., valued at about $12,000,000.

At the annual meeting on Monday of the stockholders of the New York City Railway Company the retiring directors were re-elected.

A Philadelphia party has the contract to build the Windsor, Essex & Lake Shore Rapid Railway, an electric road along Lake Erie, to be 125 miles in length and to cost about $2,500,000.

The statement from the General Electric Company that its business is now 40 per cent. greater than last year does not imply that its business for the current fiscal year will exceed that of 1904 by 40 per cent.

The travel on the Subway and Manhattan Elevated lines in New York has increased largely since October 1, and the average increase for the whole system over last year is at the rate exceeding 200,000 passengers per day.

The American Railways Company (Philadelphia) directors have declared a regular quarterly dividend of 1¼ per cent., payable December 15 to holders of record November 29. Books close November 29 and open December 6.

The Tonopah Electrolytic Gold and Silver Reduction Company was recently incorporated at Camden, N. J., with a capital stock of $100,000. The incorporators are H. Gilbert Coyle, J. Shock Summers and Wilfred B. Wolcott.

The stockholders of the Metropolitan Securities Company of New York will hold their annual meeting on December 13 and the annual meeting of the stockholders of the Metropolitan Street Railway Company will be held on December 4.

The financial statement of the Massachusetts Electric Companies for the quarter ended September 30 shows an increase in gross earnings of $83,100 and in net of $56,800. The surplus after charges is placed at $708,000, an increase of $92,400.

The Catskill Mountain & Mohawk Valley Railway Company has been incorporated at Albany, N. Y., with a capital stock of $2,000,000 to construct and operate an electric road 78 miles long in Greene, Delaware, Schoharie and Otsego counties.

The United Gas Improvement Company of Philadelphia has obtained control from Brown Bros. & Co. of Baltimore of the Philadelphia Company of Pittsburg, which has the lighting and street railway franchises in Allegheny County.

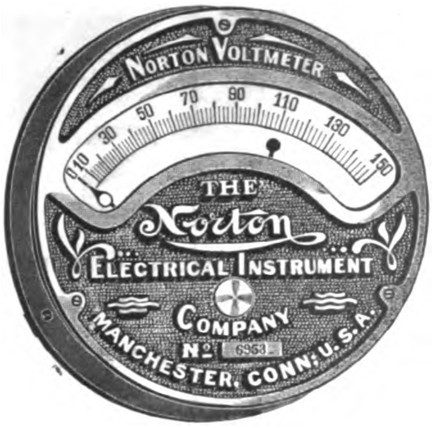
The directors of the General Electric Company have not yet reached a decision as to how much of the $11,674,500 new authorized stock will be issued at once or the price at which it will be sold to stockholders. It is likely that an announcement bearing on the plan will be made this week.

Col. A. Loudon Snowden of Philadelphia, president of the Electric Company of America, says that the executive committee is considering the making of a 10 per cent. stock allotment at par, but no action has yet been taken on the subject. This would increase the capital of the company about 40,000 shares. The proceeds would be used to pay for additional properties that the company might conclude to take over.

ELECTRICAL STOCK QUOTATIONS.

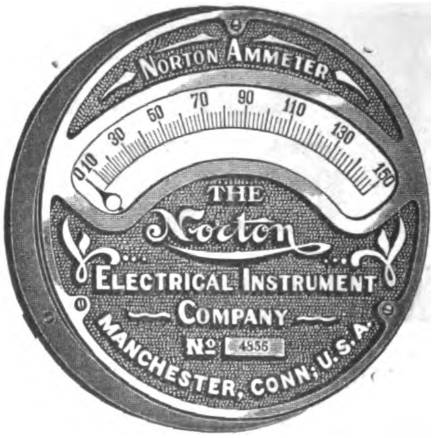
Name.	Closing price Nov. 13
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	204¼
Manhattan Elevated Railway	163¼
Metropolitan Street Railway	115¾
Metropolitan Securities	71¾
Ninth Avenue	197
Third Avenue	122
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	73¼
Brooklyn City Railway	239
New Orleans Railway	38
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81½
Philadelphia Traction	100⅝
Union Traction	62¼
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	13
do. do. do. pref	55¼
West End Street, com	99¼
do. do. do pref	114½
Chicago.	
City Railway	192
North Chicago	83
Union Traction, com	10¼
do. do. pref.	40½
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	18¼
do. pref.	59⅝
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	15¼
do. do. pref.	22
Westinghouse, com	168
do. pref.	197
General Electric	181½
Boston.	
Edison Electric Illuminating	247
General Electric	182¼
Westinghouse Electric & Mfg., com	85¼
do. do. do. pref.	100
Chicago.	
Chicago Edison	163
National Carbon, com	62¼
do. do. pref.	116
Philadelphia.	
Electric Company of America	11⅝
Electric Storage Battery, com	82
do. do. do. pref.	82
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	134
Western Telephone Company	13
New England Telephone Company	134¼
New York.	
American Telegraph & Cable Company	93
Commercial Cable Company	210¼
Mexican Telephone Company	1
New York & New Jersey Telephone Company	172¼
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93
Chicago Telephone Company	138
MISCELLANEOUS STOCKS.	
Chicago Subway	45⅜
Otis Elevator Company	61
Standard Underground Cable	..
Twin City Rapid Transit	114⅜

NORTON SWITCHBOARD INSTRUMENTS.


NORTON VOLTMETER
10 30 50 70 90 110 130 150
THE
Norton
ELECTRICAL INSTRUMENT
COMPANY
No 6953
MANCHESTER, CONN. U.S.A.

Style "C" in Ranges:

0 to 5 volts.
0 to 750 volts.
0 to 10 amperes.
0 to 1500 amperes.


NORTON AMMETER
10 30 50 70 90 110 130 150
THE
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MANCHESTER, CONN; U.S.A.

Dead Beat and made for either Back or Front Connections.

The Nerton Electrical Instrument Company,

Main Office and Factorv. Railroad Avenue, MANCHESTER, CONN.

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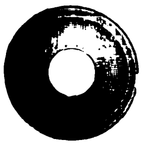
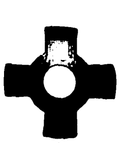
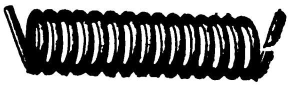
The Wallace Barnes Co.,





BRISTOL, CONN., U. S. A.,



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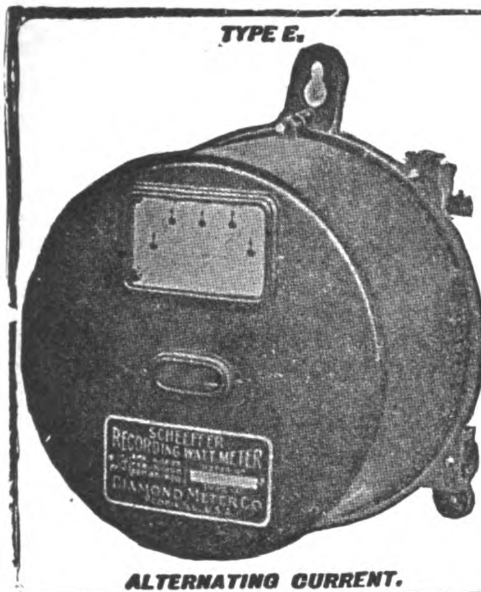
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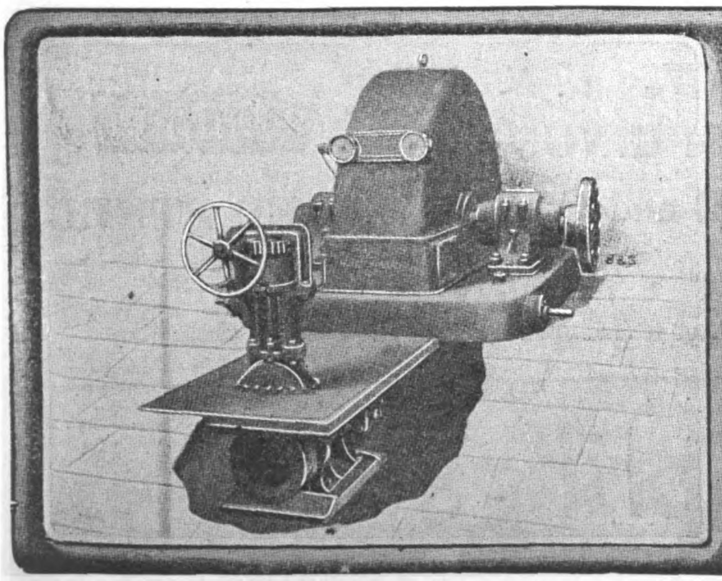

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ELECTRICITY.

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EDITORIAL NOTES.

Submarine Traffic by Means of Electricity.

Ten years from now a large part of the population of New York, New Jersey and Long Island will travel underground. Ten years from now subterranean and submarine entrances and exits will characterize Greater New York as the city of tunnels. The custom of traveling overhead will imperceptibly change into a custom of traveling underground. Traffic will be carried on in all weathers, not only beneath the foundations of New York's skyscrapers, residences and streets, but beneath the very beds of the rivers that isolate her from the mainland. The city will not be an island surrounded by water, but a city whose highways will lead into the heart of New Jersey, into the heart of Long Island and away north to the now rustic districts along the Hudson River.

Expansion from the active center will be a practical, a commercial and in many respects a social necessity. Old New York will radiate into a substantial new New York. This development will receive its greatest stimulus from the fact that all districts now across the river, on either side, will actually become a part of the solid ground of New York, the greatest influence of all being the tunnels under the East and Hudson Rivers respectively. Not one or two, but many tunnels, which in place of bridges, provide a better means of effecting this highly desirable connection. The latest reports show that the construction company has about completed its work, and the public will be invited to walk dry shod, for the first time in the history of either State, from Jersey ground to New York. The idea is to give the people an opportunity of inspecting the results of a tedious and expensive, not to say dangerous venture. It will also create an occasion for comment with reference to the means to be employed to create a long-looked-for and much needed system of rapid transit between the two States.

The conditions that will soon exist will be those developed through what can be rightly called submarine traffic by means of electricity. And it is to be distinctly understood that the great possibilities this enterprise will arouse on both sides of the river are entirely due to the means employed to make it a pronounced success. As they have been planned these means are entirely electrical in nature. The cars, the lighting, the signaling and heating will be entirely done by electricity. The tunnel will only be endurable in fact, for the obvious reason that electricity is to be the basis for all operating mechanism.

The point of greatest interest is not, however, the mere construction of the tunnel. This it seems, like the tunnel through the Alps, the one under the Thames, or any other instances that might be referred to of borings above or below the water, is a systematic operation. The results are to be expected in the course of time. But the secondary consequences of such constructive work are widespread and more than locally important. They are of immense importance because they establish certain facts of a scientific, political and civic nature. They are to date the best of evidence in favor of the use of electricity for cities so situated that a river as it were cuts them in two. New York is only one of many cases of this kind, and it is fortunate that the times are ripe for the projects completed or incomplete that will so greatly add to its growth. There is little doubt that the actual operation of the tunnels beneath the East and Hudson Rivers will but serve to show the immediate and pressing need for more. They are another example of the tremendous gains the opening years of this century have made in having electricity to serve so remarkable a purpose—its use as a guarantee of at least light, power and breathable air for nearly an unventilated mile beneath the river's bed.

* * *

Electro-Zincing Versus "Sherardizing."

The London Society of Engineers was on November 6 entertained by Mr. Sherard Cowper-Coles with an interesting paper on "The Metallic Preservation and Ornamentation of Iron and Steel Surfaces." After describing the process of hot galvanizing the author dealt with electro-zincing, or cold-galvanizing, which consists of electro-depositing zinc from aqueous solutions. A regenerative process was then described, particulars being given of the way in which zinc dust is employed to regenerate the electrolyte, and how the voltage between the electrodes is reduced by employing compound anode and cathode bars.

Mr. Cowper-Coles devoted a great part of his paper to a description of his own new process of dry galvanizing or "Sherardizing." This process, he said, had been found to be much cheaper than hot or electro-galvanizing, as there is no waste of material, whilst the expenditure of fuel is small and the plant simple and inexpensive.

A remarkable feature of this process is that iron and steel can be coated with metallic zinc, by merely bedding it in zinc dust in a drum, placing it in a furnace and raising the zinc to a temperature several hundred degrees below the melting point of that metal. Zinc dust consists of small particles of zinc coated with a film of oxide, and is produced by zinc distillation processes and must not be confused with zinc oxide.

When the drum has been charged with the articles to be treated and zinc dust, it is placed in the furnace which is heated to 500 or 600 degs. F., which is some 200 degs. below the melting point of zinc, the thickness of zinc coating being dependent on time and temperature. On opening the drum the articles are found to be covered with a silvery coating of zinc which has become alloyed or amalgamated with the iron surface.

A description was given of the application of this process for inlaying and ornamenting metals. It has also been found useful for case-hardening copper and coating aluminum previous to electro-plating, also for coating bolts and nuts, as the zinc is evenly distributed so that the threads do not require re-cutting.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Electrical and maintenance engineers of the Pennsylvania Railroad are looking into the practicability of burying the telegraph wires along the main line of that road.

◆

The Swiss Federal Council is now considering the possibility of using electricity as the traction force in the Simplon Tunnel instead of steam.

◆

President Blood of the National Electric Light Association has appointed Mr. T. C. Martin editor of "Progress," to report to the next convention of the association.

◆

The municipality of Berlin, Germany, has voted to build an underground railroad from the north to the south of that city. The line, which will cost about $13,750,000, will be electrical, and will be operated by the city. The measure still requires the sanction of the town council.

◆

The Electrical Trades Exposition Company, which will hold its first annual show in January at the Coliseum in Chicago, has sold nearly one-half of the available 38,000 square feet of floor space.

◆

A recent cable dispatch says the London County Council has decided to introduce a bill in Parliament under which the Council will construct a plant to supply all the electrical energy for London and the suburbs. The cost is estimated at $40,000,000.

◆

One of the problems which confronts the telephone engineer, says the "Electrical Engineer," London, is to obtain a cable on which the losses occurring in the line may be minimized, and one which may be at the same time commercially possible. Experiments, however, have been made on a new type of cable in Sweden, and the results are said to be extremely favorable. In manufacturing these cables, the intention had been to reduce their capacity to a minimum by passing the bare copper wires through perforated disks of insulating material and introducing the cable thus formed into an iron tube. The distance of the two conductors of the same line is 1.7 mm., that of two lines 2.8 mm., and the distance of the conductor and iron sheath in the most unfavorable case 5 mm. By this arrangement the capacity of the internal conductors of 2 mm. diameter was reduced to 0.00985 microfarad for 1 km. and that of the outer conductors to 0.0182 microfarad per kilometer. The copper wires are wound helicoidally to avoid induction effects. If the above distances be increased to 20 mm., 36.5 mm., and 10 mm. respectively, the capacity will be 0.00935 and 0.0125 microfarad.

◆

Since the advent of the electrical sign in Boston the amount of electrical current consumed has had such a notable yearly increase that Boston is said now to lead the world in consumption of electric current per capita—that is, in the number of electric light units for each man, woman and child of her population.

◆

The "Pyrophone" is a new automatic fire detector, for which it is claimed that it makes the detection of fire in its earliest stage certain, makes false alarms impossible, gives a "danger call" preceding each fire call, and requires no fixed degree of temperature in order to give an alarm. The apparatus consists of a small U-shaped glass tube half filled with mercury in each end. One branch of the tube is exposed, while the other is covered with insulating material. When there is a sudden rise of temperature the liquid in the non-protected branch expands, thus driving the mercury downwards below a platinum wire which enters the tube and causes a danger signal. If the rise of temperature continues the mercury still falls lower, and below another platinum wire, breaking the circuit and causing a fire alarm. The indicator board shows "trouble," "danger," "fire," "earth" and "battery" disks, thus providing for every emergency.

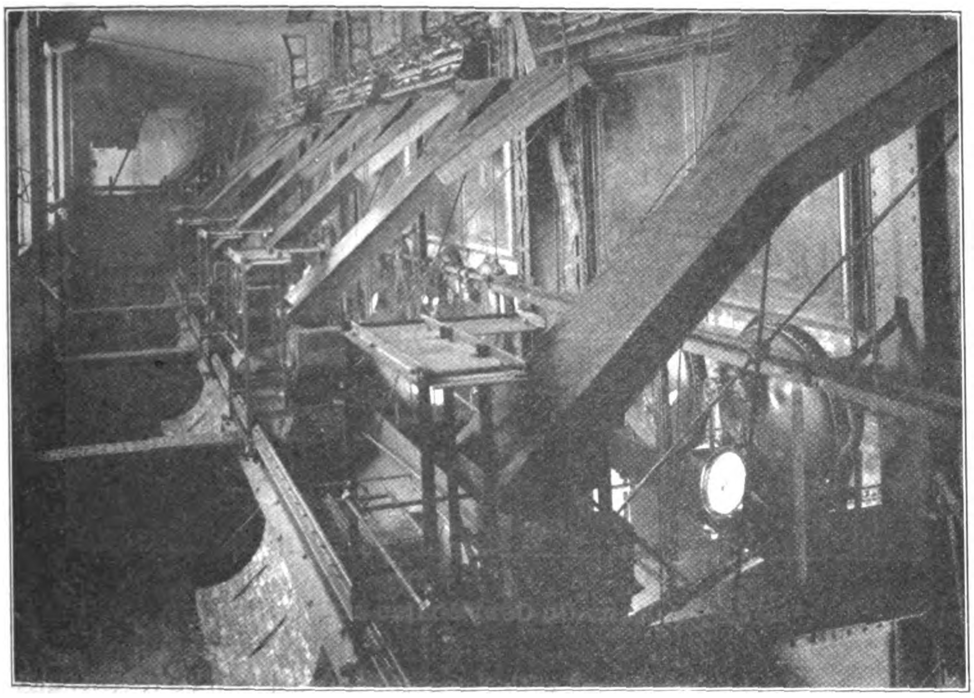
◆

For some weeks past the French War Office has been engaged in conducting experiments with a view to securing reliable communication for military purposes between Paris and the eastern garrison towns by means of wireless telegraphy. Though many difficulties had to be encountered, these were eventually overcome, and after the system had been extended as far as Vardun and Chalons, the important stronghold of Belfort was furnished with apparatus for wireless telegraphy. According to the "Electrical Engineer," London, there is now complete and permanent communication between Paris and all the eastern garrisons.

ENGLISH AUTOMATIC GRAIN AND COAL WEIGHING DEVICES.

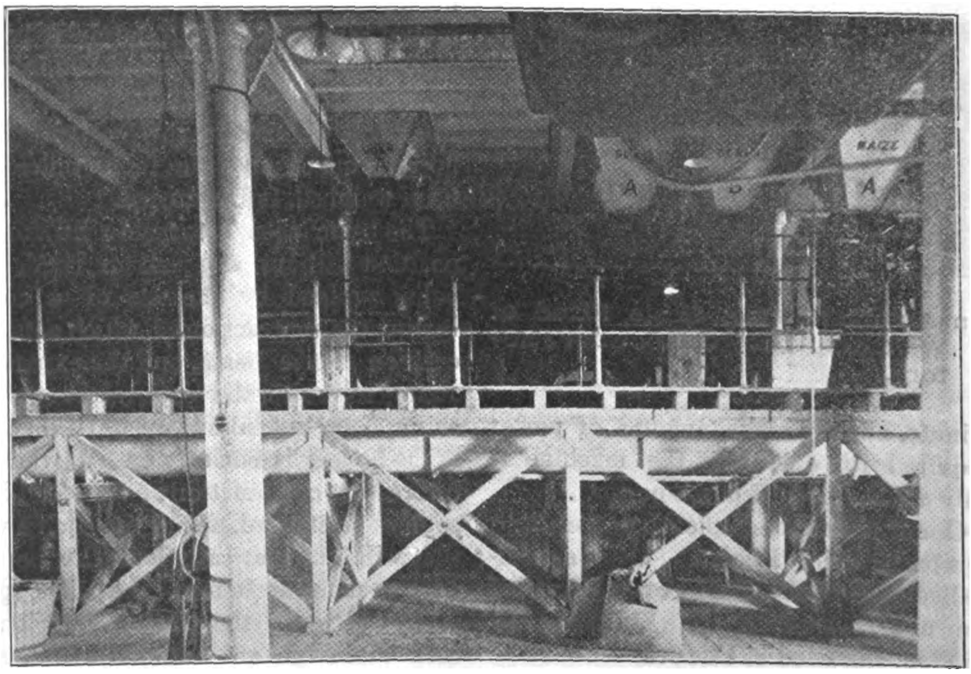
BY FRANK C. PERKINS.

Automatic coal weighing machines are now being largely employed, not only in power stations, but also at coal mines, the scales automatically weighing and recording the small coal from the mines working in connection with the coal washing plant. These machines are in operation at Chesterfield, England, at the coal mines of the Stavely Coal & Iron Company, and are also utilized at factories and manufacturing plants, machines of this type for this purpose being employed at a royal gunpowder factory in England. Automatic oil and liquid weighers are also being constructed and are in daily use at the British Oil & Cake Mills at Hull. These automatic oil scales are fitted with self-registers which count every weight made and are arranged with hoppers, having each a capacity of one-half ton of oil per each discharge. One of the illustrations show an automatic grain scale arranged for the weighing of oats, bran, beans and maize before being discharged into bags for shipment. Some of these automatic grain scales have a capacity for weighing 200 tons per hour, and form only a small part of the automatic labor-saving devices now utilized so extensively in every line of service at the present time.



Fourteen Travelling Coal Scales at Neasden Power Station.

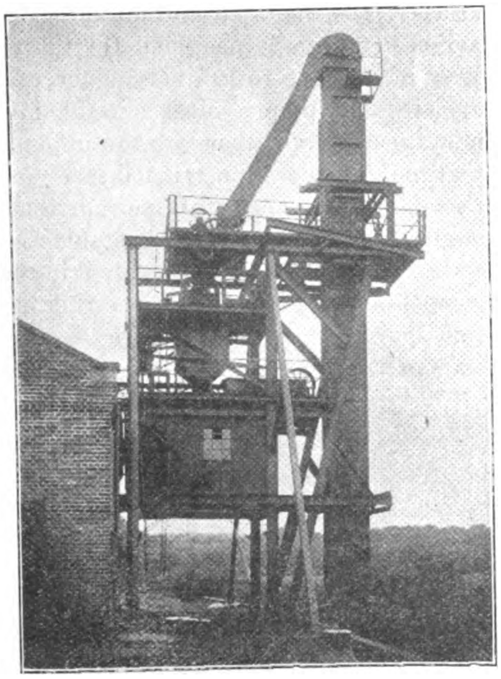
In modern power stations the coal handling apparatus is considered fully as important as any part of the power house equipment, and not only are automatic hoists and coal conveyors installed for bringing the coal automatically to the storage bin over the boilers without hand labor, but automatic coal scales are now utilized extensively for weighing the coal as it is utilized by the boilers. The weighing machines at some electric lighting stations are fed by grabs and are capable of weighing 40 tons of coal per hour. The accompanying illustrations show the automatic coal scales weighing the fuel to the boilers in modern English power plants. There are eight or more of these machines weighing coal to the boilers of the power station at Newcastle-on-the-Tyne Corporation, and double this number of scales are at work in the two power stations of the Corporation Tramways at Glasgow. These automatic scales are constructed at Birmingham by W. & T. Avery Co., Limited. There are 14 traveling automatic coal scales at Neasden power station, while other automatic weighing devices have been utilized advantageously for a considerable length of time at the power houses at Black Pool, Sheffield and other English electric plants as well as at manufacturing plants where fixed automatic coal scales are often utilized, as at the Waltham Abbey Gunpowder Factory. The weighing machines are sometimes fitted with sight registers, which show the weight from each discharge of the grab. They are also fitted with self-closing and locking doors. These English automatic coal scales are provided with access platforms immediately below the coal bunker, and the coal is delivered from the overhead bunkers to the scale below, which automatically weighs, registers and delivers the exact quantity required by the mechanical stoker attached to the boiler below the scale, one machine being usually supplied to each boiler.



Automatic Scales for Weighing Oats, Bran and Maize.

Electrically operated automatic scales have been specially designed for taking pieces of coal up to 12 inches cube, and they are said to be a most suitable machine for dealing with very large amounts at a time. They are constructed steelyard or lever principle, so that proportional weights may be used, and it is stated that this means a considerable saving in the strength of the supporting structure; some source of electrical energy is necessary, about one-half brake horse-power being required to operate this machine. Automatic coal weighers are also utilized largely with self-registering and closing apparatus. With this arrangement the load comes down intermittently, such as from a crane grab, skip or a tipping truck, and will take practically any sized lumps. The load falls into the receiving hopper which is rigidly supported so as to take the impetus, and from the receiving hopper it drops gently into the hopper below, which is the actual weighing hopper. This action automatically throws a clutch into gear, whereby the poised weight is moved along the steelyard until the balance point is reached exactly the same as in hand weighing.

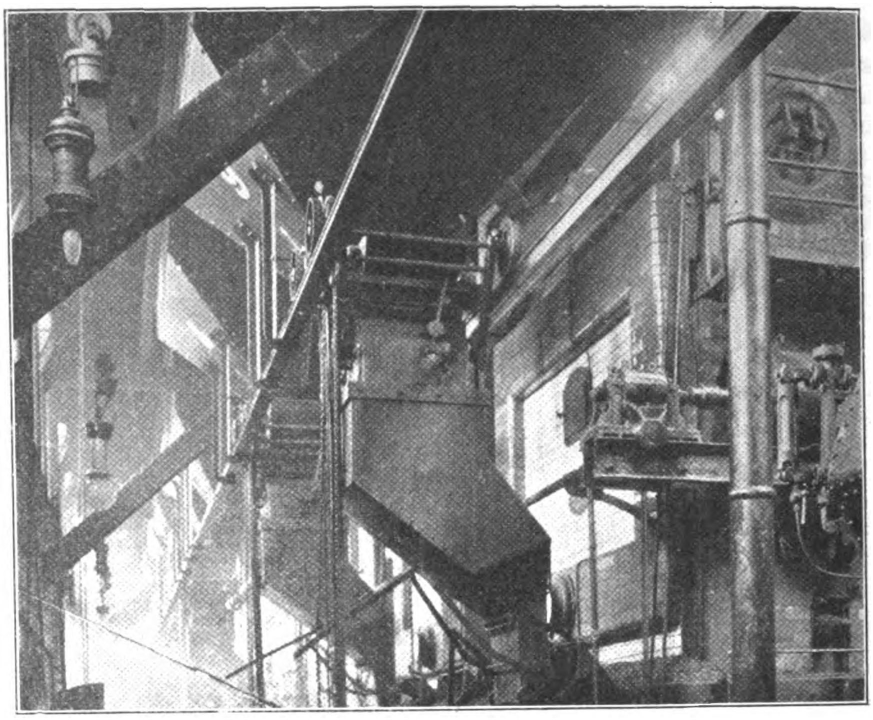
A time cam is so arranged as to now open a door at the bottom of the weighing hopper whereby the coal is released as soon as the load is taken off the machine; the poise weight returns to zero and at the same time the weight is recorded on the dials, and it is added to the total weight of the previous weighing. The machine is then ready for a fresh load, and it is stated that for machines with a hopper capacity of one or two tons the time taken is something under a minute, although the amount of power required for operating the machine is only about one-half horse-power.



An Automatic Coal Scale Fixed at Waltham Abbey Gunpowder Factory.

One of the most complete coal weighing equipments in England has been installed at the Lot's Road Power House of the underground electric railways of London, installed at Chelsea.

The coal is brought in barges to the private dock of the company from the Thames River, and the coal is raised at the rate of 100 tons per hour by a large grab and dropped into the automatic coal scale, the construction of which is such that the dust is continually removed by the action of the working parts.



Avery Automatic Coal Scales at Sheffield.

It is most interesting to see this machine weighing the coal continuously and with perfect accuracy absolutely automatically. The coal enters the machine in a large stream through two large openings until the required weight is nearly obtained, when a moving gate cuts off the supply to a very small stream so that the turn of the scale can be worked to a minimum. When the beam turns a trigger is moved, which causes the supply to be immediately shut off, and when the locking gear of the hopper containing the fuel is liberated, a door in the bottom of the hopper opens and the fuel, which has been weighed, is discharged.

The beam then returns to its former position without any jerk or thud, this being avoided by the use of a coiled spring, the contraction of which acts as a cushion to the beam, and the expansion acting to reopen the gate, although this action does not take place until the door of the hopper is entirely closed, when an interesting combination of two dead-lock cobbles is affected, acting in such a way that will automatically lock the hopper door a moment before the feed gate is opened. At the Chelsea Station at each discharge an automatic indicator registers the discharge and the exact amount of fuel passing through the machine is thus recorded at the end of a day, week or year, as is desired. A large number of automatic stokers is now being employed in Europe as well as in America, and the practice is becoming general of automatically weighing the coal by machines of this type, as the daily consumption of fuel can be registered without error.

* * *

LIGHT, HEAT AND POWER PRINCIPLES.—IX.

BY NEWTON HARRISON, E. E.

The Transformer for Light and Power.—The use of the transformer for light and power has been the means of making the alternating current system highly elastic in character. The value of the transformer as an efficient machine depends upon the extent to which it can meet the following requirements:

First—At no load the primary winding carries little or practically no current, and therefore the waste of energy is very limited when the transformer is not in use.

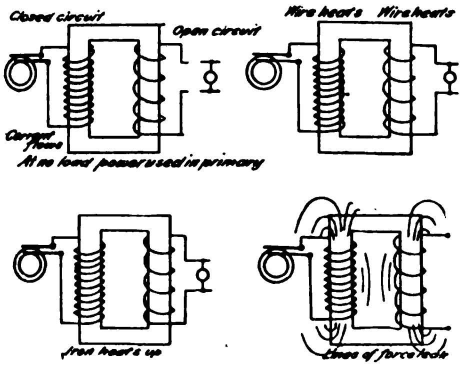
Second—That the losses in the iron of the transformer, due to eddy currents, are very small at all conditions of load.

Third—That the losses in the iron of the transformer, due to the effect of hysteresis, are limited, so as to be within the bounds of a high efficiency at all points of load on the secondary.

Fourth—That the resistance of both primary and secondary windings is such that the heat loss is not excessive at either full load or no load.

Fifth—That there is no magnetic leakage between the poles of the coils, thus causing the lines of force that should enter the cores to pass on the oustide.

Sixth—That at no load the impressed EMF. of the primary and the back EMF. of self-induction are sufficiently equivalent to prevent all but a minimum of current from passing through.



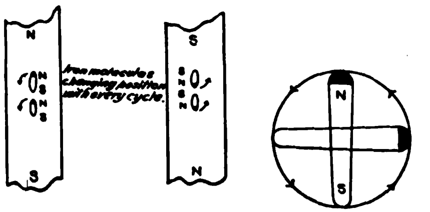
Sources of wasted power in a transformer.

To properly review the influence of the transformer upon electric light and power work it is necessary to form a correct estimate of the extent to which each of its essential elements contribute to the net result. From a general standpoint it may be said that the transformer merely consists of two coils—one called a primary and the other a secondary—wound upon a core of divided or laminated iron. The primary coil is connected to a source of impressed EMF. as it is called. The secondary is connected to the lighting or power circuit, as the case may be.

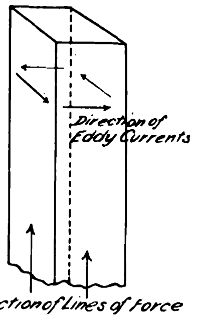
Mutual Induction.—The effect of one coil upon the other is due to mutual induction. The adjustment of the power entering the primary, so as to affect the secondary, is accomplished by the natural regulative effect of the self-induction in the primary.

It may be stated therefore without equivocation that the actual development of power in the totally disassociated secondary is due to the direct effect of mutual induction. On the other hand, the regulation of the power in the primary coil, through which power adjustments take place not only in it but in all parts of the connected system, is due to the self-induction.

Losses of Power.—The exact source of losses of power in the transformer may be summed up in the following list: First, losses in pressure in both primary and secondary, due to the natural or ohmic resistance of the wire; second, losses of power in watts, arising through the development of heat in the said coils and commonly called the C^2R loss; third, losses in the iron which are due to two distinct causes—(first, the development of minute parasitical currents in the iron itself, which consume energy called eddy currents, and, second, to the effect of hysteresis, caused by the constant reversals of magnetism), all of which combine to raise the temperature of the iron. Thus, influences will be at work to heat the coils, unless provision is made to hold them in check. And in addition other influences are at work to heat the iron, which must be similarly understood and held in check. The alternator generating the current now employed so widely is not one whit more important than the transformer, whose function is that of raising or lowering its pressure. A very efficient alternator delivering, say, 100 kw. to the transformer or transformers in its circuit, may not lose more than 10 per cent. of its energy in the entire process of generation and distribution. Of the 100 kw., about 90 kw. will be on tap for consumers' use whenever required.

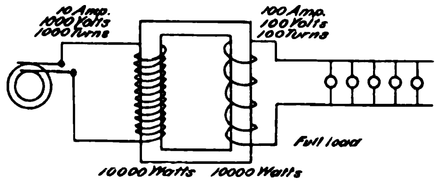

N
S
Iron molecules changing position with every cycle.
S
N
N
S
A complete rotation of the molecule

Rotation of an iron molecule during magnetization and reversed magnetization.



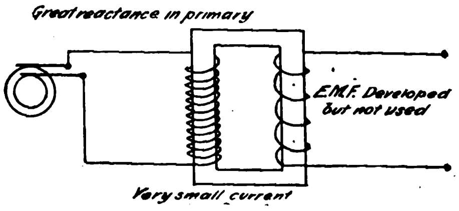
An enlarged iron sheet, showing eddy currents.

Ratio of Pressures.—The two pressures of the transformer are called the primary electromotive force and the secondary electromotive force. The exact ratio of these two pressures is the exact ratio of their windings in theory and practice. For instance, if 1,000 turns on the primary take 1,000 volts, then 100 volts from the secondary can be obtained by means of 100 turns. The ratio is therefore as follows: EMF. of primary : EMF. of secondary, as the turns of the primary are to the turns of the secondary. A simple rule of this character also presents the facts with respect to the current as well. For instance, if the number of watts in the primary are 10,000 and the current in the primary is 10 amperes, then, as 10,000 watts are practically delivered by the secondary, the current in amperes, at 100 volts pressure, would be 10 times as great, or 100. The rule therefore appears, relating to this, as follows: The current in the primary is to the current in the secondary as the pressure in the secondary is to the pressure in the primary. This is represented by the symbols in the following manner, both with regard to the pressures and windings, as well as the ratios of the currents: $E_p : E_s = S_p : S_s$ as regards the electromotive forces and primary and secondary windings; also $C_p : C_s = E_s : E_p$ as regards the currents and electromotive forces.



Ratio of windings, volts and current in a transformer.

Without Load.—When there is no load the secondary of the transformer is said to be on open circuit, and the current in the primary is at its lowest value. The electromotive force induced in the primary coil through self-induction is so high that only a small difference exists between it and the EMF. sent in from the alternator. This difference of EMF. is useful in keeping the primary coil choked as it were. Under these conditions, namely, of open circuit for the secondary, the primary coil represents a simple case of a highly self-inductive coil in circuit with an alternating current. Its inductive reactance under these conditions is obviously at a maximum. The value of pL is therefore sufficiently high to prevent any but a very small current from operating.

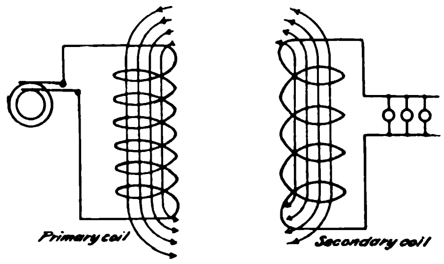


Inductive reactance with secondary open.

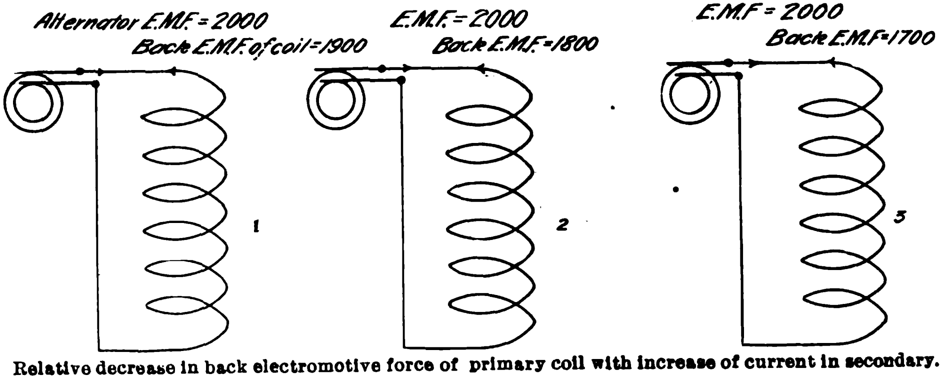
At this point the transformer represents a negligible consumption of power. Should it be otherwise, however, a case exists of where power is being unduly wasted as a consequence of bad design. If 100 transformers are considered, taking on an average of from .1 to .2 of an ampere apiece, the total power consumption at 2,000 volts would be 100 × .1 × 2,000, or 100 × .2 × 2,000, equal respectively to 20,000 or 40,000 watts. The design of a transformer therefore must be such that the waste of power at no load is extremely low, otherwise a power leak or waste will appear which may seriously affect the financial returns. The primaries of the transformers of an extensive system of electric lighting are regarded as costing a definite sum per annum for power losses.

Inventions made for the purpose of automatically cutting out the primaries when the secondary circuits are opened have not proved practicable.

With Load.—When the secondary of the transformer is closed the amount of current flowing into the primary and secondary immediately becomes automatically regulated by inductive influences. Even though the secondary is open, the mutually inductive effect of the primary is such, as to cause electromotive force to be generated in it. In other words, although no current flows in the secondary, it is in certain respects no different from the armature of a generator on open circuit. The field is actively operating, but the conductors of the armature, though generating EMF., cannot cause a current to flow until the circuit is closed. When this occurs in the case of the secondary, when it is being used to generate current for lighting or power purposes, the current flowing in it exercises a reverse magnetic influence to that in the primary. In fact, the effect is such that not only is the amount of magnetism in the transformer cut down, but the back EMF. of the primary is necessarily cut down, and in consequence the EMF. of the secondary as well. The case, as here presented, is that of the closing of the secondary, causing current to flow in that coil, thereby magnetizing its core in a reverse direction to that caused by the primary, thus cutting down the magnetization of the primary and permitting more current to enter it. The fact to be noted, however, is that a very slight difference between the EMF. impressed upon the terminals of the primary by the alternator and the EMF. induced within the coil of the primary through self-induction, will be quite sufficient to send a greatly increased current through the primary. Regulation here, in this respect, is very delicate, and it is evident that both the increased magnetization due to the increased ampere turns of the primary, and the increased but reverse magnetization due to the current in the secondary will very nearly balance. In other words, the magnetization of the primary and the demagnetization of the secondary will be approximately equal. Under these conditions, the magnetization of the transformer iron under all conditions of load will remain practically unchanged.

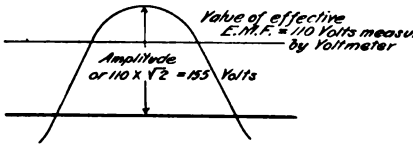


Opposing magnetizations of primary and secondary.



Relative decrease in back electromotive force of primary coil with increase of current in secondary.

Relationship of Primary and Secondary Current.—The current in the primary is controlled by the degree of mutual induction taking place between it and the current in the secondary. The coils are only the mediums through which they operate and affect each other. Their lines of force are the essential and fundamental basis of all reactions. The primary is therefore magnetically as much a part of the secondary, as the secondary is a part of the primary. Each is mutually sensitive to changes taking place in the other. The current in the primary could not increase unless the secondary by its reaction permitted it. It is evident that the only way in which the current in the primary can increase is by a reduction of the difference between its impressed and its back EMF. But to lower the back EMF., it is necessary to reduce the inductive reactance, a thing only possible by reducing the number of lines of force producing it. Under these circumstances, it is evident that the only efficient means to employ (were none other available) would be to reduce the number of lines of force, as they are automatically reduced by the current in the secondary. When the secondary circuit is closed the amount of current flowing through it is dependent upon the amount of resistance in the outside circuit connected to it. For this reason, as more and more incandescent lamps are turned on in the secondary circuit of a transformer, the resistance is reduced more and more, and in consequence a heavier volume of current flows through the secondary coil. As more current flows through the secondary coil, its reverse magnetizing effect to that of the primary coil cuts down the total amount of lines of force to just the extent required to permit only enough extra current to flow in the primary to do the work required. In other words, when the primary gets more current it is because the secondary takes more current. On the other hand, when the primary takes less current it is because the secondary has reduced its quota of current by the turning off of lamp circuits, etc. Both the iron and the copper in these specific cases are merely the mediums which carry the energy employed. In the one case the energy as current, and in the other case the energy as magnetism.



Difference between the commercial or effective pressure and the maximum or amplitude.

Calculating the EMF. of the Coils.—The two electromotive forces of the primary and secondary respectively can be calculated by means of a simple formula embracing the total number of lines of force, the total turns and the frequency. The formula is as follows:

Total lines of force in core = volts $\times 10^8 \div 4.44 \times$ turns of wire $\times$ frequency.

For instance, in showing its application, if the volts required are 1,000, the frequency 100, and turns of wire 1,000, the formula would then represent: total lines of force in core $= 1{,}000 \times 10^8 \div 4.44 \times 1{,}000 \times 100$ equals 225,225. The lines of force in the core would not be very high per square inch for reasons that will be readily made obvious. The calculation of volts, lines of force or turns is manifestly dependent upon the arrangement of the formula. To get turns, the formula is arranged as follows: Turns $= E \times 10^8 \div 4.44 \times$ total lines of force $\times$ frequency. To get volts, the formula reads: volts $= 4.44 \times$ turns $\times$ maximum lines of force $\times$ frequency $\div 10^8$. In this formula, the total lines of force are the maximum created by the current in the primary coil. The volts obtained by this means, however, are the effective volts. The maximum volts divided by the $\sqrt{2}$ equals the effective volts, or the volts read off from an alternating current voltmeter. According to this last calculation, a 110 volt alternating current lighting circuit is supplying an effective or commercial pressure of 110 volts, but a maximum pressure of

$$110 \times \sqrt{2} = 110 \times 1.41 = 155 \text{ volts.}$$

This is called the amplitude of the pressure, and is the highest point reached by the sine wave of electromotive force.

Iron Losses.—The reason why the magnetism in the core is not made high is because of the effects of hysteresis. By some this has been called molecular friction. But it is readily understood as the phenomenon causing energy to be absorbed during the process of magnetization and a reversal of magnetism. The greater the number of lines of force per cubic inch of iron in the transformer core, the greater the energy absorbed in the process referred to of reversing it. Therefore, the magnetization in transformers, is limited to a certain safe maximum. Beyond this point a great waste of power and high temperature in the iron are inevitable. This is called the limit of the the flux density.

EARTHED AND UNEARTHED RADIATORS IN WIRELESS TELEGRAPHY.*

BY W. H. ECCLES, D.SC.

Recent commendations of certain new Lodge-Muirhead wireless telegraph stations equipped with insulated oscillators and resonators of the 1897 English patent, make the moment opportune for a brief review of the reasons and facts that have made the use of the earthed radiator almost universal and the use of one unearthed rather exceptional. A plain statement of the present position of the rival cults—the earthed and the unearthed—in the light of widely-accepted theory, can be made and is best made without recourse to mathematics.

In the early days of Hertzian space telegraphy (say 10 years ago) the solution of the signaling problem was expected in the employment of straight beams of electrical radiation. The electric rays used, produced of course in the Hertzian manner, were to be projected in any desired direction and were to be capable of penetrating all obstacles between sender and receiver. Hence it was that radiation of short wave length generated at the focus of a parabolic mirror was the vogue among the "wireless" experimenters of that day. It was probably in an endeavor to get a bigger output of radiation per spark that Marconi in 1895 connected large insulated conductors—storehouses—to one side of his oscillator. Contrary, perhaps, to what he had expected, signals were better when these insulated conductors were lifted to a distance from the earth (and their capacity thus reduced) and better still when the far side of the spark-gap was earthed. In fact, capacity in itself seemed of so little account that the large elevated conductor could be removed and the connecting wire left supported alone in the air without greatly diminishing the strength of signals. Thus Marconi followed Popoff, without copying him, to the use of the plain earthed air-wire, originally designed, it seems, by Popoff for other purposes than wireless telegraphy.

The scientific basis, as we understand it, of these rapid successes of Marconi have been given numberless times. We see clearly enough now that it supports Marconi's own opinion that his success was largely due to the use of the earthed air-wire. It is necessary here to write down once again the virtues, as oscillator and radiator, of the long vertical earthed air-wire. Put shortly, its merits are: First, its great length insures slow vibrations, and therefore long waves; second, it sets the waves up so that the electric force in a wave front is, from the very beginning, in a vertical plane; third, what is partly implied in the last, it attaches to the surface of the earth the free ends of the moving lines of force; fourth, it is a good radiator (and absorber). Long waves are advantageous, largely for reasons connected with diffraction; the setting vertically of the electric force near the earth avoids losses such as would otherwise occur from the generation of profitless currents in the earth's substance; and the attachment of the waves to the earth's surface prevents them straying wholly into space and gives them such guidance (similar to that given by a wire to the current it carries) as enables ranges of hills to be surmounted without suggestion of penetration. But the air-wire's power as a good radiator, valuable at a time when the object was to "get there," has become in this era of syntonic ambition its cheapest fault if it is in itself the whole oscillator; for, as has often been explained, rapid radiation shortens enormously the train of effective waves, if, as must be in the case of the simple air-wire, the energy stored electrostatically, just before each spark, is small. There is no need to do more here than mention that by using a closed (non-radiating) oscillator of great energy capacity to feed a simple air-wire, sustained trains of waves can be emitted and the earthed air-wire thus retained in its old post of honor.

At a very early stage of this story, Lodge seems to have perceived this inadequacy of the simple air-wire for syntonic working; and, at least as early as 1897, was using in preference a symmetrical Hertzian wave-maker. The one at Heysham, for example, consists of two horizontal conducting plane areas about 80 feet square, one vertically above the other, and connected to it by a vertical central wire about 80 feet long. The lower square is about 3 feet from the ground, and, like the upper, is insulated. The vertical wire is interrupted at its middle by a spark gap. This structure is, from its geometrical configuration, a slower generator than a simple air-wire, and gathers before each spark a much greater charge. For both reasons it produces trains of waves more sustained than those of an air-wire. Moreover, it possesses most of the merits of the plain air-wire. It makes very long waves, and it sets them up with their moving lines of force in vertical planes. But it fails in this, that it does not attach the waves to the earth's surface. The waves have to do that for themselves, as they may do when free later on. To compensate for this, however, there stands the complete freedom from earth connection. What this means can only be appreciated by recalling *one*, let us say, of the difficulties that beset the radiator that is earthed—namely, the variability in the goodness of the "earth."

This variation of quality of "earth" did not matter so much in untuned working, but in tuned telegraphy it is more important; and when making comparisons with the Lodge-Muirhead wave-maker we must look to tuned systems. Suppose then, that in a syntonic transmitter the radiator is tuned to the closed feeding circuit when there is a good earth, and that by some means the earth goes bad—i. e., acquires an unwonted resistance. Then, inevitably, foreign overtones, of kind and strength depending on the badness of the earth, are introduced into the vibration. These overtones are produced at the expense of the fundamental by reflection, at the resistance of the pulses descending the air-wire. There is, besides, absorption of energy in the resistance; indeed it has been shown both theoretically and experimentally, that with a certain critical resistance the absorption of the vibrations in the resistance may be extremely rapid. If this last condition is ever happened upon in practice, it must be of serious import even where forced vibrations of the correct period, namely, that of the distant receiver, can be maintained upon the transmitter air-wire by a heavy feeding system behind it. All these considerations apply with equal or even greater force to the earthed absorbing wire of the receiving system. Hence, it will be seen, to be earth-free is something worth striving for. Thus the question is, does the attainment of this desideratum by the Lodge-Muirhead wave-maker compensate fully for the fact that the waves as at first emitted are free, that is, unattached to the earth's surface?

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*From the "Electrician," London.

If one traces in imagination the movements of the lines of electric force near the Lodge-Muirhead radiator when in action, he concludes that the lines which detach themselves from the conductor to form waves appear as rings situated in vertical planes passing through the vertical central wire, moving outward horizontally with the speed of light and expanding as they go. They will resemble, in fact, the rings familiar to us in diagrams of the ordinary Hertzian oscillator, but will probably be more distorted than those in the pictures and will include a smaller proportion of the whole number of lines of force initially present in the fully-charged oscillator. As each ring moves forward and expands, its lower bend strikes the earth and is reflected or absorbed there. If the earth's surface were of very good conducting material, the lower half of each ring would ultimately be folded up towards coincidence with the upper half. Now, in this process of reflection, the direction of the horizontal component of electric force is reversed. Thus high reflection at the earth's surface would involve considerable strengthening of the waves near the earth—just where strength is wanted. As a matter of working experience, this strengthening by reflection seems not to be experienced at the earth's surface in any degree so completely as has just been indicated; but it is well admitted that the earth's surface cannot be supposed a perfect conductor. The folding up of the lower half of each looped line of force is probably very incomplete. Allowing for this, it seems possible that perhaps one-half of the whole wave energy—the half carried in the lower portion of each ring of force—may be wasted ohmically in the earth comparatively near the radiator. On the other hand, the earthed radiator, placed normally over a conducting sheet (the earth to which it is connected) detaches, in the popular theory, half-rings, which move outwards in vertical radial planes, with their cut ends sliding perpendicularly over the conducting plane. This arrangement seems ideally perfect. But here again the earth's surface is, in reality, not a good conductor. Therefore, in the very act of electrical vibration—which may be interpreted, as is well known, in terms of positive and negative reflections of electricity at the top and bottom of the earthed air-wire—great wastage may occur before the detachment of the waves. In both cases lines of force traveling over a bad conductor must acquire a forward slope which will involve the propagation of energy into the earth, or, to put it in another way, will involve the creation of currents in the earth's substance with consequent ohmic losses. Taking all this into account, however, as well as may be done by these descriptive methods of examining the question, the advantage, on the whole, seems to lie with the earthed radiator. The conclusions we are driven to amount, in fact, to these: That in the case of the Lodge-Muirhead radiator working over the badly-conducting earth a 50 per cent. ohmic loss of the whole output of radiation is possible; whereas with the earthed radiator there are losses in vibrational energy amounting probably to a smaller figure.

SINGLE PHASE RAILWAYS IN EUROPE.

(From our London Correspondent.)

Up to the present there is not in England any example—even experimental, unless it be at Trafford Park where the British Westinghouse Company were going to put down a short section, though we have not heard of its completion—of an electric railway operated on the single phase alternating current overhead collection system. The railways that have so far electrified certain sections have all dropped third or fourth rail direct current working. It is true that the intention of the London, Brighton & South Coast Railway Company to equip a short single phase section in the neighborhood of London was announced some time ago, and that electrical firms of eminence in England and abroad have been engaged upon the consideration of the matter, but so far as the writer knows the contract has not yet been placed, and it will be long before this experimental section will be operating and be affording the railway managers and directors of England that practical data regarding the comparative working of direct current and single phase systems on actual English lines for which they are at present thirsting.

Electrical authorities, however, who have kept themselves fully informed regarding the developments which have been occurring in America and in Continental Europe in single phase traction, are doing their level best to insure for that system an intelligent consideration not only from railway men but from the general public too. Prof. Silvanus P. Thompson, Sir William Preece and other electrical engineering authorities are persistently urging the claims of the overhead conductor method as against the drawbacks attending the employment of live surface conductor rails. The educational influence of all this writing in newspapers, and in the technical press, regarding experience and actual performance in other countries must be very considerable; it is one of those things of which it never will be possible to accurately gauge the extent to which it influences the ultimate settlement.

As this article is being written an issue of the Engineering Supplement of the London "Times" has just appeared (November 1) in which several correspondents engage in controversy respecting the wisdom or otherwise of adopting the third rail for the London Metropolitan. Mr. H. F. Parshall writes, replying to the criticisms of Prof. S. P. Thompson, and remarks that under given conditions either system may be the more advantageous. He says that in an electrical system the third rail is the most reliable and the least troublesome element in the whole traction system. "For heavy traction," says Mr. Parshall, "it cannot be lightly put aside and superseded by something yet to be proved suitable for the same class of work." Sir Alexander B. W. Kennedy writes that "many English engineers, including myself, both believed and pointed out, long before the matter was taken up on the Continent and by Americans, that the single phase system with one overhead conductor was the only probable solution of the heavy railway question, and our opinions seem now to be shared by engineers generally."

The Union and A. E. G. concerns of Berlin (now one organization) were responsible for the first European single phase equipment undertaken. The lines they have equipped with the dates thereof are: (1) Opened August, 1903, 4.1 km. of line between Niederschoeneweide and Spindlersfeld with two motor cars, the pressure being 6,000 volts and the frequency 25 cycles; (2) July, 1904, the 18 2 km. Stubaithal railway with four motor cars, the pressure being 2,500 volts and the frequency 42 cycles.

Next in order there followed the completion of the first portion of the Borinage District Railway, and as this section has been operating for a few months only, and a good many miles are now equipping to complete the scheme, a good deal of interest is being taken in it at the present moment in England. It being the latest representative of such work in Europe, some particulars of the undertaking will be given, but before doing so it should be stated that the short experimental single phase line which the A. E. G. is putting down for the Swedish State Railway Department with a 6,000 voltage, a 25 frequency and two motor cars with 100 hp. motors, is to be completed shortly; the same company is also engaged upon a much larger undertaking, involving the supply of 51 motor cars, with a 6,000 voltage and 25 cycle frequency, for the Blankenese-Ohlsdorf Metropolitan & Suburban Railway.

To return to the Borinage District Railway, one of the chief features of the electric lines is the high frequency employed, viz., 40 cycles. The Stubaithal line was the first high frequency line inaugurated; it employed a current of 42 cycles, and the results which have attended the operation of the system are said to have been so satisfactory that the A. E. G. felt amply justified in employing an almost equally high frequency for Borinage.

The District Railway belongs to the Societe Nationale des Chemins de Fer Vicinaux, which owns all the Belgian District Railways, and controls more than 2,000 kilometers of track. It is interesting to observe that this company has from the first been conspicuous for the adoption of an enlightened policy in dealing with the subject of electric traction. Five of its lines are already so equipped; the heavier lines are still worked by steam, though the company is watching events closely, awaiting the happening of justifying performances to make the change. The first section in this great southern coal mining district of Belgium to use single current, is about 21 kilometers long, but the extensions will consist of another 108 kilometers. It is the intention that this 129 kilometers shall be entirely fed from one point with single phase alternating current at 40 cycles and 6,600 volts. For the present equipment the pressure of 6,600 volts is transformed down to 600 volts (the trolley wire pressure) by track transformers. The extension lines will, however, have a higher tension for the trolley wires, and the necessity of line transformers will in consequence be avoided.

The railway runs chiefly through streets in populous districts, but there is private track in places; for the most part the track is laid single.

Electrical energy for working the system is purchased from the Societe d'Electricite du Borinage, which supplies light and power to the district. The generating station is arranged for high tension three-phase current to meet the requirements of many customers for motor power. The switchboard was arranged for giving a 6,600 volt single phase current to the railway. The generators are star-connected, two larger ones, 40 pole, being so built that they each have a capacity of 375 kva. single-phase current by using any two phases of the star connection, or 375 kva. three-phase current at 40 cycles. There is a smaller generator which has 36 poles, and can deliver 225 kva. single, or three-phase current. All the machines give 6,600 volts as phase voltage. Only two phases of each three-phase dynamo are thus used for working the railway, and this it is claimed to prove that light and power can be obtained, and a single-phase railway worked from one three-phase power station without the necessity of frequency transformers or special single phase machines.

The high tension wires are carried from the switchboard to the distributing tower direct. They are carried from the power station on wooden masts, special double-pole conductors being led from the switchboard to each of the four transformer brick huts, whose positions were chosen with the idea that besides the trolley wires, no further low tension feeding wires should be provided. All four stations work in parallel on to the trolley wire, which is not divided into separate sections.

There being telegraph and telephone earth return lines in the neighborhood the rails are not allowed to be used as a return for the railway current, so double trolley wires are used. They are arranged 90 cm. apart, and are grooved wires of hard drawn circular copper. Double T-iron channels are mostly employed for the masts, and bracket suspensions are adopted wherever possible, cross-pole suspensions only being present in a few cases.

The line pressure being only 600 volts the trolley wires are hung tramway fashion, the new track material of the A. E. G. being used. At one point there is a specially low bridge where the distance between the trolley wire and the rail level is only 3.35 km. To avoid accidents here it is provided that the wires under the bridge shall remain without current when no car is passing through. As the car approaches the bridge the guard closes a special switch which allows the current to run along the trolley wire and after the car has passed through the switch is again opened by the guard.

As to the rolling stock, this is of plain description, for working class traffic is the chief custom. Each car holds 20 persons seated and 20 standing. There are no special trucks, but the axle-bearing holders are fastened direct on to the longitudinal box carriers, which run straight through from one end of the platform to the other. The car body is hung on spiral springs and also supported by long plate springs.

To each car there are two Winter-Eichberg motors (type W E 31B), having a capacity of 40 hp. on a one-hour rating; these are six-pole motors for 40 cycles and 550 volts average pressure. The motors work by means of a toothed-wheel gearing on the axles in the usual manner. The control is effected by series parallel control in connection with a regulating transformer which is suspended on brackets under the floor in the center of the car by means of bolts, the brackets being suspended on the longitudinal car supports.

A train consists of one motor car and two trailers. The motor cars have two current collectors mounted on a strengthened part in the center of the roof of the car, side by side, at a distance of 90 mm. from each other.

The complete motor car weighs 9.95 tons without passengers, the share of the electrical equipment being 3.7 tons.

Only a temporary car depot has yet been built.

Windmills for Lightships, etc.

The Canadian exploring steamer "Arctic" (Captain Bernier), which has made an extended voyage North poleward, is provided with a novel electric light installation. Since fuel cannot be obtained for the generation of steam, and as the ship will have to spend many months in darkness, it was decided to install an air-compressor plant which is being operated by a windmill. The compressed air is then used to drive the generators, which in turn furnishes current for charging the storage batteries used for lighting the vessel.

It would seem that windmills might similarly be utilized on board of lightships and alongside of lighthouses, for generating electricity for illuminating purposes and for the signal lights, in connection with electric storage batteries.

On Nansen's ship "Fram," there was a windmill electric set installed to give power during her Arctic voyage, and a similar set was placed on the ship

"Discovery" during her Antarctic exploring expedition, both of which worked admirably.—"American Shipbuilder."

MUCH LEGAL ADO ABOUT A TINY PIECE OF WIRE.

(From the New York Times November 19.)

Of all the patent lawsuits which have been waged in this country, perhaps none was ever more remarkable than that which came to a halt with the decision of Circuit Judge Hoyt H. Wheeler a few days ago. It was the case of the "Fessenden liquid barretter." The world heard merely that Judge Wheeler had decided in favor of Mr. Fessenden—only a few persons knew what days and nights of toil had been spent on account of a little wire that weighs a minute fraction of a grain and can hardly be seen without a microscope.

There are four volumes of the testimony taken by Commissioner John A. Shields. They weigh 35 pounds. The little wire which is responsible for all this bulk of evidence can be found with difficulty when it rests in the palm of one's hand.

Eminent patent lawyers were employed by the two contestants, Reginald A. Fessenden and the De Forest Wireless Telegraph Company. Besides the attorneys themselves—and there were more of them than are usually to be found in a sensational murder case—there were scores of unseen but hard-working assistants at work for months, busy delving into foreign lore devoted to inventions; there were translators to turn the French or German references into English, and there were experts drawing big fees to give their testimony.

The case has been going on for nearly two years, and it may be that the end is not yet. The De Forest attorneys still have a certain time in which to enter an appeal.

Mr. Fessenden invented his device in 1901. The scene of his labors was a lonely little island named Manteo, on the eastern coast of North Carolina. He continued his investigations at Old Point Comfort, Va. F. K. Vreeland, who worked with him in his experiments, figured in the litigation as a rival claimant to the invention. The court decided that Vreeland had no claim.

Whatever the merits of the case were or were not, Fessenden contended that the De Forest Companies were guilty of an infringement of his patent, and he brought an injunction suit in January, 1904. The complainant's proof covered 77 printed pages—and that was only a far-distant warning of what was to come later. Every day the case seemed to grow more complicated. The attorneys for both sides introduced as evidence technical records which might have driven the Judge to distraction had he not had long years of experience in the study of technical questions involved in patent cases.

To the man who is not familiar with wireless telegraphy the whole affair is very puzzling. The end of the little platinum wire, forming one of two electrodes, is immersed in a liquid. A continuous current passes through the liquid gap between the electrodes. The manipulation of a telegraph key hundreds of miles away causes variations in this current, and these variations, transmitted to a telephone, produce sounds corresponding to the letters of the telegraphic alphabet.

The number of minor claims and counter-claims in the case was so great that it would take a long time to catalogue them. At any rate, Judge Wheeler granted a permanent injunction restraining the De Forest Companies from using the device. If it is appealed, the case will go to the Court of Appeals of the Second Circuit.

The attorneys spent so much time and toil on the case that they got to carrying around microscopes in their pockets. These microscopes had to be brought into frequent use by both counsel and Judge. Even ordinarily patent lawyers have to know a great deal of electricity, mechanics, and other such scientific subjects, but in this case there was unusual need for thorough technical knowledge on the part of both lawyers and Judge.

The money spent by the contestants amounted to many thousands of dollars. The experts' fees alone would be nearly enough to float a corporation, and nobody knows just how much went to the lawyers, the referees and others concerned in the case.

Utilization of Victoria Falls.

The London "Times" announces that according to Reuter's Agency, the question of utilizing the Victoria Falls for the generation of electrical energy and its transmission to the Witwatersrand is receiving close attention at the hands of the African Concessions Syndicate. American and Continental engineers are agreed that such a project could be made commercially successful, especially as the climate is most favorable to the scheme, being extremely dry, whilst there is no ice in the rivers to interfere with the working of the turbines, and no snow to break down the transmission lines. It is estimated that in the dryest season yet experienced 500,000 hp. could have been developed The available head of water is about 330 feet, but a head of 1,000 feet could be obtained by engineering works of a comparatively light type. This head of water would produce 1,000,000 hp. At present, according to "Electrician," London, $15,000,000 is spent annually on power on the Rand.

New Hydraulic Electrical Stations.

Two new hydraulic electrical stations are to be built in Lyons, France. In one a 200 feet head in the Romanche River will afford energy for 10,000 hp., which will be transmitted as three-phase current over a line 90 miles long. The other plant, which will be located at Moutiers, will supply 5,000 hp. direct current at a pressure of 57,000 volts, and the current will be carried 110 miles over two overhead bare copper wires. Where it enters the city the conductors will be placed underground in well-armored cables. The current will be transformed to a lower voltage for commercial use by five motor generators. This is the first instance in which direct current of such a high pressure has been used in this manner, and also the first instance in which direct current at any pressure has been transmitted to any such distance.

Incandescent Lamps and Fires.

The extended use of electricity in mines gives rise to the belief that the dangers thereof are increased owing to the possibility of explosions caused by the heat from the lamp igniting the coal dust. This was demonstrated by a fire which took place at one of the collieries in the North of England some time ago. Investigations were then carried on by Mr. Hall, inspector of mines, who in a report states that in one case where a 16-cp. lamp was slightly covered with coal dust the temperature rose to 370 degs. F. in 10 minutes, and that in another case the lamp exploded at 450 degs. F. in four minutes, while a temperature as high as 650 degs. was registered in a third case. Mr. Hall remarks that after the coal dust has been raised to a certain temperature, spontaneous combustion commences.

Committee on Rates and Costs.

President Blood of the National Electric Light Association has reappointed the Committee on Rates and Costs which made report to the Denver convention. The committee consists of Messrs. Chas. L. Edgar, chairman; Louis A. Ferguson, Samuel Scovil, Frank W. Frueauff, P. G. Gossler and R. S. Hale.

Meeting of the American Society of Mechanical Engineers.

The 52d meeting of the American Society of Mechanical Engineers will be held in New York City during the first week in December. The headquarters will be at the Edison Auditorium, 44 West 27th street, the two upper floors being used.

The opening session, at which President John R. Freeman will present the annual address, will be held on Tuesday evening, December 5. The second or business session will be held Wednesday morning in the main saloon of the steamship "Amerika" at the docks of the Hamburg-American Line at Hoboken, N. J. Following this session a special train will take those desiring to make the excursion to the new Worthington Hydraulic Works at Harrison, N. J.

Wednesday evening there will be an illustrated lecture at the Edison Auditorium by Prof. R. W. Wood, of Johns Hopkins University, on "Photography of Invisible Phenomena."

The third session will be on Thursday morning, and besides the presentation of professional papers there will be a discussion on the subject of "Bearings." Thursday afternoon there will be a reception at the New York School of Automobile Engineers, 146 West 56th street.

The usual reception at Sherry's will occur on Thursday evening. The closing session will be held on Friday morning and will be devoted to the presentation of professional papers.

New York Electrical Society.

The 254th meeting of the Society will be held at 19 West 44th this (Wednesday) evening at 8 o'clock. Mr. O. S. Lyford, Jr., will lecture on "The Electrification of the Long Island Railroad."

Ohio Engineers' Meeting.

The eleventh annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers, held at Canton, November 17 and 18, was largely attended and a number of important papers were read and discussed. The delegates inspected the engineering plants in Salem and Alliance.

Telegraph Companies Not Liable.

Judge Sanborn, of the United States Circuit Court of Appeals, in three decisions handed down last week at St. Paul, Minn., holds that a telegraph company is obliged to use only ordinary care in determining the identity of senders of messages, and that losses sustained by persons whose names are improperly used are not to be held against the telegraph company. One suit was against the Western Union Telegraph Company to recover damages caused by the delivery of an unauthorized message alleged to have been signed by an Iowa bank guaranteeing payment of a draft for $8,972. The other two cases, also from Iowa, were similar.

Big Street Car System Sold to a Steam Railroad Company.

The United Traction Company of Albany, N. Y., controlling the street car system of Albany, Troy, Rensselaer and Cohoes, has been sold to Delaware & Hudson interests.

The sale of the property was announced after the meeting on Saturday last of the directors of the company as a result of two years' negotiations. Anthony N. Brady represented the stockholders of the company.

A circular issued Saturday night announces that all the directors have agreed to sell holdings, and that the sale is to be made at $150 a share, which price is available to all stockholders who deposit their stock before November 28 with the National Commercial Bank of Albany. The price is conditioned upon the surrender of at least 51 per cent. of the entire outstanding capital stock of the company before that date.

The price of $150 a share represents a total purchase cost of $7,500,000 for the stock of the United Traction Company.

Prof. J. L. Morris Dead.

Prof. John L. Morris died last Saturday night at Ithaca, N. Y., aged 73. Until he retired last year Prof. Morris had been at the head of the Mechanical Arts Department of Sibley College since 1868.

Proposals Invited.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until December 5 for furnishing Eastern Navy Yards with the following electrical material: Schedule 238, incandescent lamps; schedule 239, arc lamps; schedule 241, indicating fuses. Blank proposals can be obtained at the Navy Pay Office in New York or upon application to the Bureau at Washington.

Captain B.B. Buck, constructing quartermaster at Fort McPherson, Ga., is inviting sealed proposals until December 1 for furnishing and installing electric light fixtures and making service connections between secondary lines and main line switches at Fort McPherson.

Sealed proposals are being invited until December 8 for furnishing the San Francisco depot of the Quartermaster's Department with a quantity of incandescent lamps. Detailed information will be furnished upon application to Major C. A. Devol, depot quartermaster at San Francisco, Cal.

ELECTRICAL PATENT RECORD

LETTERS PATENT ISSUED NOV. 14, 1905.

Electric Railways and Appliances.

804,297-298. Safety and Automatic Crossing System for Railways. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, same place. Filed May 15 and June 1, 1905.

804,371. Electromagnetic Wheel. Hugh Behan, Seattle, Wash. Filed Jan 6, 1905.

804,587. Car-Fender. Stefan Ebenschweller, Allegheny, Pa. Filed Aug. 3, 1905.

804,648. Trolley. Michael Baker, Chicago, Ill. Filed Aug. 31, 1904.

804,745. Electrically-Controlled Fluid-Pressure Railway-Brake. John S Lockwood, Kansas City, Mo. Filed Feb. 5, 1904. Renewed March 24, 1905.

804,763. Process of Electrically Welding Rails. Carl Pahde, Breslau, Germany. Filed July 11, 1905.

804,790. Car Fender. August J. Berg, Chicago, Ill. Filed July 12, 1905.

Electrical Machinery and Apparatus.

804,344. Electrically Switching Apparatus. Walter J. Richards, Milwaukee, Wis. Filed Nov. 4. 1904.

804,355. Dynamo-Electric Machinery. William L. Waters, Milwaukee, Wis. Filed Dec. 5, 1904.

804,389. Electric-Circuit Closer. Alexander Dow, Detroit, Mich. Filed Jan. 22. 1904.

804,438. Transmission Mechanism. Charles G. Simonds, Schenectady, N.Y., assignor to the General Electric Company. Filed June 23, 1904.

804,440. Dynamo Electric Machine. Charles P. Steinmetz Schenectady, N. Y., assignor to the General Electric Company. Filed April 22, 1904.

804 595. Electrical Controller. Nathan K. Garhart, Indianapolis, Ind., assignor to the Garhart Dental Manufacturing Company, same place. Filed May 25, 1905.

804,628 Electrical Generator. Morris Schwartz, New York City, assignor, by mesne assignments, to the New York Electrical Generator Company. Filed March 7, 1905.

804,636. Electric Snap-Switch. George B. Thomas, Bridgeport, Conn., assignor to the Perkins Electric Switch Manufacturing Company, same place. Filed Nov. 3, 1904.

804,783. Circuit-Controller for Explosive-Engines. Richard Varley, Englewood, N. J., assignor, by mesne assignments, to the Autocoil Company. Filed Oct. 31, 1904.

Telephones and Telephone Apparatus

804,256. Signal for Telephone-Switchboards. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Filed July 11, 1902.

804,279-280. Transmitter. Anthony Van Wagenen, Sioux City, Ia., assignor, by mesne assignments, to the Clark Automatic Telephone Switchboard Company, Providence, R. I. Filed April 30 and May 4, 1896.

804,431. Telephone Instrument. Egbert A. Reynolds, New York City, assignor to the Iron Telephone Company, same place. Filed Aug 19, 1904.

804,742. Push-Button Switch Mechanism for Telephones. Burton L. Lawton, Meriden, Conn., assignor to the Connecticut Telephone & Electric Company, same place. Filed Dec. 5, 1904.

Miscellaneous.

804,291. Electrical Apparatus for Producing Ozone. Albert C. Wood, Philadelphia, Pa. Filed Feb. 17, 1905.

804,365. Device for Preventing Contact in Telegraph Line-Wires. William L G. Appleby, Germantown, Md., assignor of one-half to Isaac N. Simpers, Germantown, Md. Filed Oct. 7. 1904.

804,603. Branch Block for Electric Wiring. Nathan B. Hoyt and James H. Martin, New Haven Conn., assignors to the Elm City Engineering Company, same place. Filed Nov. 14, 1904.

804,759. Electrical Heater. John A. Noble, San Francisco, Cal., assignor of one fourth to Edgar C. Gribble, one fourth to Alonzo C. Gribble and one-fourth to James Davis, San Francisco, Cal. Filed May 8, 1905.

THE TELEPHONE WORLD.

Telephone War in Prospect.

It is evident that a telephone war is on in Tecumseh, Neb. An Independent company is being organized among the business men, and the Bell company has long maintained an almost complete service in Johnson County, a large exchange being in force in Tecumseh. Much complaint has been made concerning the service given by the Bell company, the Commercial Club having been asked to take a hand in the matter. Relief was promised by the telephone company, but that did not head off a movement for an Independent company. Mr. Otto Wettstein, Jr., of La Porte City, Ia., has been in Tecumseh endeavoring to organize the new company and has met with sufficient encouragement to warrant the new enterprise.

A Network of Independent Lines.

The Stantonville, Tenn., Telephone Company is erecting poles for the purpose of extending its lines to Parsons with a view of putting in an exchange in that place. It will also extend its line to Camden. The various counties in that section are a perfect network of Independent telephone lines, and there are many private lines in operation. The farmer who is not in telephonic communication with his neighbors and with the nearest town is not up-to-date.

At the recent convention of the Texas Independent Telephone Association, held in Dallas, each of the 75 Independent companies having lines in Texas were represented at the meeting. The principal subjects discussed were the promotion and general interest of the Independent companies in the State, the matter of adjusting toll line rates, and the completion of the Independent telephone companies, clearing house. After the general business was over the directors who had been elected met to perfect the organization of the Independent Telephone clearing house, which is to be established in Dallas. The following officers of the clearing house were elected: President, Cecil L. Simpson, of Dallas; vice-president, E. P. Butler, of Gainesville; secretary and treasurer, E. W. Dunaway, of Paris. The directors decided upon Waco for the next place of meeting, at such time as the executive committee shall decide to call the members together.

An Independent telephone company has been organized to install a complete system of telephones in New Wilmington, Pa. The company is being organized in opposition to the Bell system. The required capital will be furnished by local capitalists.

H. W. Trimble, foreman of the Nebraska Telephone Company, is now engaged in Blair, on the extensive repairs being made by the company. The new system is expected to be in full operation and all work completed by the first of the year. All the old 'phones are to be removed and will be replaced by up-to-date ones.

The Nebraska Telephone Company is building a farmers' line near Pickrell.

A telephone strike seems to threaten the Mutual Telephone Company of Des Moines, Ia.

Victory for Home Telephone Company.

Decisive victory for the Home Telephone Company in its struggle with the Cumberland Telephone Company was the result of a vote of the Springfield, Tenn., city council, when that body decided unanimously not to interfere with the franchise granted to the Home Company about one year ago to do business in Springfield.

For some time petitions have been circulated asking the city council to declare the franchise of the Home Company ferfeited because of failure to take advantage of the rights granted within a reasonable time. The petitions also declared two companies unnecessary, and that another system would cause many inconveniences and expenses to the patrons of the telephone. Such petitions were circulated, it is alleged, in behalf of the Cumberland Company.

The city council, by its action, held that a reasonable time in which to begin building has not expired, and the Home Company may proceed to comply with the terms with the support of the town authorities. The company now has its poles, preparatory to erecting lines, and will begin work at once. E. L. Barber and A. L. Tetu, the men at the head of the Nashville Home Telephone Company, are behind the company and the opening of an office will give Springfield Independent telephone communication with a number of other places where allied Independent companies have lines.

The action of the city council in opposing the attempt to obstruct the Home Company in efforts to come into Springfield meets with general approval.

The claim is made that the Cumberland Telephone Company has never been granted a franchise in Springfield, and has no right to run its lines over the streets.

Directors' Meeting Postponed.

The meeting of the directors of the United States Independent Telephone Company, scheduled to be held in Rochester, N. Y., last week, has been postponed until November 23, when it is expected all the directors of the new corporation will be present.

The American Telephone & Telegraph Company's October net output of instruments was 133,199, against 62,988 one year ago, and from January 1 the net output was 976,852, against 564,672 in the same period last year. The total number of instruments outstanding is 5,457,416, compared with 4,344,189 one year ago.

The Delmarvia Telephone Company of Wilmington, Del., lately destroyed about 1,000 of its old instruments.

The Farmers & Merchants' Telephone Company of Beaver Springs, Pa., has been incorporated with a capital stock of $6,000.

C. E. Stinson, of the Toledo, O., Home Telephone Company has been appointed consulting engineer for the Indiana long distance and the Indianapolis city plant.

The Cumberland Telephone Company is erecting a building in White Bluffs, Tenn.

Telephone Bonds.

The Independence, Mo., Home Telephone Company through its president, Theodore Gary, of Macon, Mo., has filed a mortgage deed of trust in Independence in favor of the Pioneer Trust Company of Kansas City to secure $150,000 in bonds recently authorized. The bonds are to run for 20 years at 5 per cent. Of the amount of money to be raised by the sale of the bonds, $50,000 is to be used in paying for the plant as it now is, $25,000 in immediate betterments, and $75,000 as a reserve for future improvements.

Farmers to Have Telephones.

Articles of organization have been filed for the Brown County, Wis., Telephone Company with a capital stock of $10,000. The company has been incorporated by three Green Bay men—State Senator Henry F. Hagemeister, Charles A. Straubel and F. J. B. Duchateau—for the purpose of building and operating a toll and local telephone system between Green Bay and the town of New Denmark. It is the intention of the corporators to have the company's line ultimately extended to Manitowoc, and also in other directions.

The private telephone between Green Bay and Senator Hagemeister's stock farm in the town of Bellevue, it is announced, will be used as a nucleus for the first span of the system.

The intention of the promoters is to have work started early next spring.

The controlling interest in the Monrovia, Cal., Telephone & Telegraph Company, which owns the Home Telephone franchise in Monrovia, has been taken over by Dr. West Hughes, of Los Angeles. The office of president is held by Dr. Hughes, J. M. Baldwin has been elected vice-president and manager, and F. N. Hawes, of the American National Bank, secretary-treasurer. These, with F. J. Cornes, are the board of directors. An improved system is promised.

It is stated that the total number of Independent telephones in Indiana at the present time is about 175,000. This enormous development has been achieved within six years. There have been fewer failures among Independent companies than in any other class of business, and no company has been in the hands of a receiver.

The Bradford, N. Y., Telephone Company has been incorporated to operate between Bath, Savona and Bradford. The capital of the company is $2,000 and T. W. Chase, of Bath; F. S. Owenshire, of Urbana, and Edgar Sanford, of Bradford, are the directors.

Announcement has been made of the sale to the Home Telephone Company of Kansas City, Kan., of a controlling in the Ottawa Telephone Company. The new concern takes control of the plant December 1.

The Home Telephone Construction Company of Los Angeles, Cal., is a newly organized concern. The directors are as follows; Carl L. Doran, C. G. Andrews, Philo Jones, M. Andrews and G. Doran, of Los Angeles. Its capital stock is $500,000.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Ashburn, Ga.—This town is considering the installation of an electric light plant and waterworks, and preliminary surveys have been made by J. B. McCrary, of Senoia.

Astoria, Ore.—W. W. Whipple has secured a franchise to construct an electric light and gas plant, also a telephone system.

Beaumont, Tex.—The Beaumont Saw Mill Company is arranging for the installation of a complete electric light plant.

Bluff City, Tenn.—An electric light company has been organized here with J. D. Haun, president; W. E. Wolfe, vice-president, and J. H. Bachman secretary and treasurer.

Buena Vista, Ga.—An election will be held December 11 for issuing bonds for an electric light plant. There is no doubt but that the bonds will be issued, as the whole town is very enthusiastic over having an electric light and waterworks system.

Chetek, Wis.—The citizens are desirous of having an electric light plant.

Crawfordsville, Ind.--J. F. Davies, of Toledo, O., has secured the contract for repairing the city electric light plant.

Fort Payne, Ala.—The Alabama Cooperage Company of this place has made application to the council for an electric light franchise.

Fort Smith, Ark.—John W. Howell, Joseph G. Branch and others of St. Louis, Mo., have applied for a franchise to construct and operate an electric light plant.

Galva, Ill.—Dr. B. S. Peck, Randolph Boyd and others have petitioned the village board for a franchise to establish an electric light plant.

Grand Forks, N. D.—Edward A. Healy, of Red Lake Falls, has a plan to supply electric light for this city, and has been here talking over the venture to the local business men. His plan is to utilize the power of Thief River Falls to generate current, which if extended here will furnish cheap light.

Grand Island, Neb.—The Grand Island Electric Company has been incorporated with a capital stock of $60,000 by Arthur F. Vila, G. H. Payne, Irving F. Baxter and others.

Huntsville, Ala.—A number of local citizens are agitating the question of the city making a bond issue sufficient to erect and equip an electric light plant.

Jonesboro, Ind.—The Trowbridge Company of Chicago has purchased the Jonesboro light and water plant, and will make extensive improvements, one of which will be a 24 hour service.

La Barca, Mex.—Francisco Castallanos proposes to establish an electric light and power plant here.

Loveland, O.—The Loveland Citizens' Electric Company has decided to issue $50,000 bonds to be used for extension of the plant.

Minneapolis, Minn.—At the special election held here last week, the proposition to issue $35,000 bonds for the building of a municipal electric lighting plant was carried by a large vote.

Mineral, Kan.—The Sun's Rays Electrical Company has asked for a franchise to install an electric light plant here.

Morganton, N. C.—An electric light and power plant will be erected here by the Morganton Furniture Company, lately incorporated with a capital stock of $125,000.

Norfolk, Va.—In order to make further extensions in its plant for the purpose of increasing its electric lighting facilities, the Norfolk Railway & Light Company contemplates shortly an outlay of $100,000.

Osborne, Kan.—Frank A. Higley, of Cummings, has asked the city council for an electric light franchise, and proposes to put in a lighting plant here if given a free site for the power house.

Sacramento, Cal.—E. J. Carragher is clerk of a committee appointed to find ways and means of establishing a municipal electric lighting plant.

Scottsburg, Ind.—The city council has granted a franchise to James Smith for an electric light plant.

South Hanson, Mass.—A new company will soon be incorporated in this town, known as the Hanson Gas & Electric Company, with W. E. Damon as president.

Terre Haute, Ind.—This city is to establish its own electric lighting plant.

Texarkana, Tex.—S. B. Whiteside and G. West have applied for a franchise for an electric light plant here.

Toledo, O.—The citizens have voted in favor of the issuance of bonds for the purpose of building a municipal electric lighting plant.

Wesson, Miss.—The city council is negotiating for the purchase of the electric lighting plant, now owned by a private company.

White Bluffs, Tenn.—There is talk of waterworks and an electric light plant for this place.

Williamsburg, Ky.—Gleaves & Company of Lynchburg, Va., propose to construct and own waterworks and an electric light plant here to cost about $45,000. J. A. Gilman is the engineer.

STREET RAILWAYS.

Canal Dover, O.—Engineers are at work surveying the land between here and Alliance, for the purpose of estimating the cost of building an electric railway between the two cities via Bayard, Magnolia and Bolivar.

Cincinnati, O.—The Cincinnati Belt Railroad Company, which proposes to build an electric railway to Garry, both freight and passenger, has been incorporated with a capital stock of $18,000 at Columbus, by Jacob Joseph, P. Peurrong, O. C. Evans, K. F. Beckhardt and V. Q. Price.

Ephrata, Pa.—The citizens have started a project for the construction of a new trolley line from here to Lincoln, with the expectation of subsequently extending it to Lebanon.

Frederick, Md.—The Dodge surveying corps, employed by the parties who propose to build another trolley line connecting this city and Hagerstown, is still at work.

Fort Wayne, Ind.—An electric road from this city to South Bend, a distance of 80 miles, passing through a prosperous farming country with a population of 1,752 to the mile, connecting two of the best cities of this State, and opening a territory which is now reached directly only by wagon roads, is what is promised by the Fort Wayne-South Bend Air Line Traction Company.

Hatboro, Pa.—The right of way for the proposed trolley route from Newtown to this place has been secured and officials say the work of construction will begin early next spring.

Morgantown, W. Va.—Work will begin on a trolley line April 1, to connect this city with Fairmont. Senator Elkins and Joseph H. McDermott are the promoters.

Oakland, Cal.—Articles of incorporation of an electric railroad to run from Marysville to Nevada City, and thence to Auburn, were lately filed here under the name of the Midland Railroad Company.

Petersburg, Ind.—The city council has granted a franchise to the West Baden, Louisville & Vincennes Electric Road, giving it the right to enter this city upon any street except the main business thoroughfare.

Sherman, Tex.—Local officials of the company to construct and operate the proposed electric line from this city to Gainesville announce that the contract has been awarded, and the work will be commenced soon.

POWER PLANTS.

Birdsboro, Pa.—The Birdsboro Electric Light & Power Company will erect a power plant along the Schuylkill road.

City of Mexico, Mex.—V. Martinez, of this city, will build an electric plant for the transmission of power at a place between the States of Morelos and Guerrero.

Detroit, Mich.—The big Commonwealth Power Company has nearly completed negotiations for purchasing the water power rights of the Huron River above Ann Arbor. The probable purchase price is said to be close to $150,000.

BIDS WANTED.

Boise City, Ida.—W. N. Donaldson, of the Boise Valley Electric Railroad Company, gives information that the company is in shape to proceed with the construction of the line to Caldwell. Bids are invited for the equipment of 30 miles more of road. The conditions of the call for bids require that the successful bidder shall be ready to begin shipments within 30 days.

New York City.—Sealed bids or estimates will be received by C. B. J. Snyder, superintendent of School Buildings, at the Department of Education, corner of Park avenue and 59th street until 11 o'clock A.M. on November 27. No. 1 for installing fire alarm telegraph system in public schools 2, 4, 5, 7, 8, 9, 10, 12, 13, 15, 30, 32, 39, 40, 47 and 111, Borough of Brooklyn. No. 2 for installing electric equipment in new public school 149, on the south side of Sutter avenue, between Wyona and Vermont streets, Borough of Brooklyn. On contracts Nos. 1 and 2 the bids will be compared and the contract awarded in a lump sum to the lowest bidder on each contract. Blank forms may be obtained and the plans and drawings may be seen at the office of the superintendent at Estimating Room, Hall of the Board of Education, Park avenue and 59th street, Borough of Manhattan; also at branch offices, No. 131 Livingston street, Borough of Brooklyn.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 16⅝@16¾c.; Lake 16⅝@16¾c.; casting, 16⅜@16½c.

The annual meeting of the stockholders of the West End Street Railway Company of Boston will be held November 28.

The Interborough Rapid Transit Company of New York is increasing the number of its employes. About 500 new men are required.

The Kings County (Brooklyn) Electric Light & Power Company's quarterly dividend of 2 per cent. will be payable December 1.

The Electric Company of America (Philadelphia) will shortly issue about $500,000 of new stock. This will be offered to stockholders at par.

General Manager Stebbens, of the Appleyard electric lines in Ohio, announces that the properties will be offered for sale within the next 60 days.

The Philadelphia Electric Company has declared the regular semi-annual dividend of 2½ per cent., payable December 15 to holders of record November 24.

In the first 17 days of November the Amalgamated Copper Company is said to have sold 48,000,000 pounds of copper, deliverable as far ahead as February.

The Washington (D. C.) Railway & Electric Company has declared the regular semi-annual dividend of 2½ per cent. on its preferred stock, payable December 1.

The president of the Chicago & Milwaukee Electric Railway Company has closed a deal for the purchase of the franchise of the Kenosha (Wis.) Electric Railway. The consideration was $350,000.

In spite of the continuous decline of Metropolitan Street Railway and Metropolitan Securities, large holders have maintained an air of confidence which, as a certain banker familiar with the property put it, conveys the impression that "they have something up their sleeves."

The recent advance in Brooklyn Rapid Transit and the buying of the stock by Philadelphia houses was considered as partial corroboration of the designs of the Pennsylvania Railroad "inside crowd" on Brooklyn Rapid Transit. Insiders of the latter talk bullish, but give no very active assistance to the bull movement.

Comptroller Grout announces that he will take steps to prevent the United States Independent Telephone Company from doing a general telephone business in New York under the franchise of the old Mercantile Electric Company. The New York Independent Telephone Company acquired control of the Mercantile Electric Company recently.

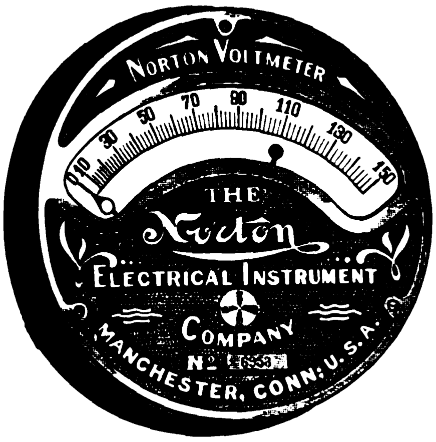
The voting trust of the Lake Shore Electric Company was voluntarily dissolved on Saturday at Cleveland, O., the properties subserved by it having been rehabilitated to such a degree that its services were no longer necessary. The trust was constituted at the outset of the Everett-Moore troubles in 1902. The property now reverts unhampered to its owners. The line extends from Cleveland to Toledo.

Preferred stockholders of the Bullock Electric Company of Cincinnati, which is controlled by the Allis-Chalmers Company, may exchange dollar for dollar until December 12 for preferred stock of the Bullock Electric Manufacturing Company. At present the stock is guaranteed 6 per cent. for 23 years. The new stock is guaranteed at 6 per cent. for unlimited time, is cumulative and is preferred as to assets and liquidations.

ELECTRICAL STOCK QUOTATIONS.

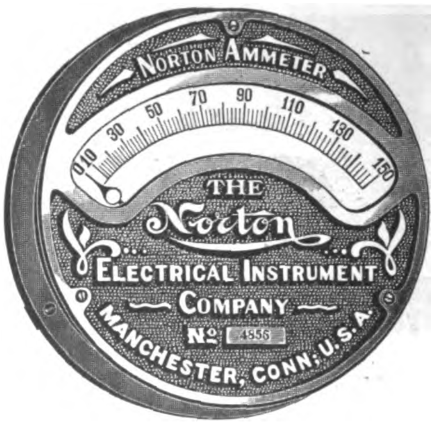
Name.	Closing price Nov. 20
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	214¼
Manhattan Elevated Railway	163½
Metropolitan Street Railway	116⅛
Metropolitan Securities	72¼
Ninth Avenue	197
Third Avenue	122
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	84¼
Brooklyn City Railway	239
New Orleans Railway	38
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81½
Philadelphia Traction	100¾
Union Traction	62½
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	13
do. do. do. pref	57
West End Street, com	98
do. do. do pref	114
Chicago.	
City Railway	192
North Chicago	83
Union Traction, com	10⅛
do. do. pref.	41
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	20⅛
do. pref.	62¼
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	15½
do. do. pref.	22
Westinghouse, com	168
do. pref.	197
General Electric	186¼
Boston.	
Edison Electric Illuminating	247
General Electric	186¼
Westinghouse Electric & Mfg., com	85½
do. do. do. pref.	100
Chicago.	
Chicago Edison	163
National Carbon, com	62½
do. do. pref.	116
Philadelphia.	
Electric Company of America	11⅝
Electric Storage Battery, com	82
do. do. do. pref.	82
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	135½
Western Telephone Company	13
New England Telephone Company	135
New York.	
American Telegraph & Cable Company	93
Commercial Cable Company	210¼
Mexican Telephone Company	1
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92⅞
Chicago Telephone Company	138
MISCELLANEOUS STOCKS.	
Chicago Subway	49¼
Otis Elevator Company	61
Standard Underground Cable	..
Twin City Rapid Transit	117

NORTON SWITCHBOARD INSTRUMENTS.


NORTON VOLTMETER
10 30 50 70 90 110 130 150
THE
Norton
ELECTRICAL INSTRUMENT
COMPANY
MANCHESTER, CONN. U.S.A.

Style "C" in Ranges:

0 to 5 volts.
0 to 750 volts.
0 to 10 amperes.
0 to 1500 amperes.


NORTON AMMETER
10 30 50 70 90 110 130 150
THE
Norton
ELECTRICAL INSTRUMENT
COMPANY
MANCHESTER, CONN. U.S.A.

Dead Beat and made for either Back or Front Connections.

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Main Office and Factory, Railroad Avenue, MANCHESTER, CONN.

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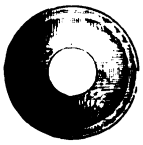
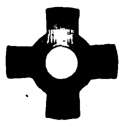
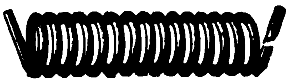




BRISTOL, CONN., U. S. A.,



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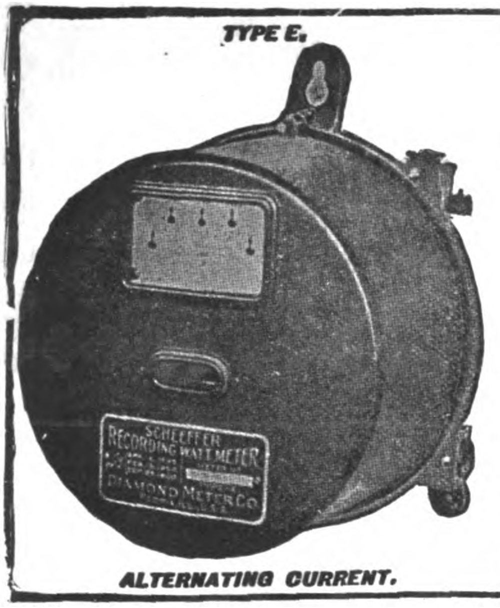
TYPE E.
SCHEEFFER RECORDING WATT METER
DIAMOND METER CO.
ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER

Type E for Alternating Current Type F for Direct Current Circuits

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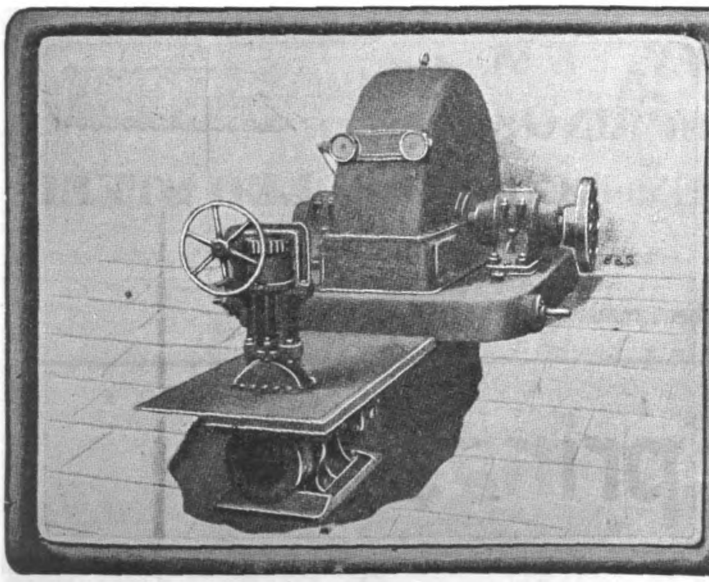
TYPE F.
SCHEEFFER RECORDING WATT METER
PATENT APPLIED FOR
DIAMOND METER CO.
PEORIA, ILL. U.S.A.
DIRECT CURRENT.



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ELECTRICITY.

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EDITORIAL NOTES.

The Transformation of Central Stations.

Since the question first arose as to whether electricity would ever become a force of commercial use tremendous strides have been made in the direction of making it an essential element of everyday life. But it is not alone this widespread application of electricity to lighting and power which demands attention. It is a matter of more interest to examine into the character, and the changes in character, which have occurred in the *ensemble* of those sources of electrical energy commonly called central stations. This change in *ensemble* has been noted by modern-minded engineers as a proof of the elasticity of present day practice. It is a striking evidence of the degree to which changes are instituted on the basis of a well founded, though partially crystallized, scientific principle. To be more explicit, it may be stated that a rapid transformation is taking place in the design of the operating mechanism of central stations. As a central station is best designated as an institution in which electricity is generated for direct distribution and consumption, it may not be difficult to understand how changes occur in the class of machines housed under such a roof. These changes are very marked at certain intervals, indicating transformations through definite periods. Formerly the change was one indicating a strong tendency to use large multipolar units instead of a variety of small two-pole machines. Of necessity this expansion led to the abolition of the use of small high speed engine units, and the heavier build of slow moving engines of the marine type took their place. Thus the station was gradually evolved from the first period of development, consisting of small bipolar dynamos belted to high-speed engines, into the second stage of growth, represented by a series of large slow-speed multipolar generators, direct connected to correspondingly heavy engine units. What can be called the third period of development, now regarded as the most radical of its kind in the last half century? The answer to this interrogation is best found in the statement that the third stage of central station development and transformation is discovered in the introduction of the turbine.

It might be asked, how can the introduction of the turbine affect the central station so markedly? Or in what respect are such advantages gained that the substitution of one type of steam consuming apparatus for another is to be hailed with approbation? Only a purely commercial reply can be made to this inquiry. It is decidedly cheaper to install and employ turbines than engines. The lowering of the expense is found in the more limited rate of depreciation; in the greater economy of operation and in the reduced consumption of oil. The greater ease of coupling is not as great or as important an item as the reduction in floor area. It is far better to produce continuous rotation by steam or any other power if possible than a series of disconnected and reversing impulses. The reciprocating engine is thus debarred by natural law from standing on the same plane of mechanical perfection as the turbine. As there is in this, as in the generator, only rotation to consider, it is not susceptible to the same wear and tear as a mass of linked mechanism needing constant attention and careful lubrication. This therefore is the point of greatest interest—the saving in labor for care and attention. The explanation of the transformation of central stations into turbine-driven plants is thus found; in one instance emphatically, but in all other instances as an economical measure as well. If floor space can be occupied to better advantage then more generating units can be installed. The logic of this, the general use of the turbine, seems to be not only a saving on all sides, but what is equally important, an ability to utilize the space of the central station to such advantage that a greater income can be secured from it. Viewed from this standpoint, it is evident that the three steps of progress as enumerated are as beneficial financially as scientifically, and certainly as advantageous commercially as practically. As an additional fact, it may be stated that, according to the latest statistics, more than 900,000 hp. in turbines are now in use, largely in central stations.

* * *

Radium and Lead. Radium and lead are supposed to be closely related to each other, according to the surmises of one or more of our distinguished electro-chemists. The emanations of radium are supposed at present to pass through evolutionary changes. In one instance one of the so-called elementary forms is produced; in another instance, another of these products. Radium as now understood produces alpha, beta and gamma phenomena, as they are called. But it has been noted that the geological conditions under which uranium ore is found, and the drift of the present theories regarding it, all point in the same direction. Molecules represent a heterogeneous assemblage of atoms. The atoms represent planetary systems in which occasional disruptions take place. When such events occur the process spoken of, the transmutative process, will give rise to the gas helium. The breaking up, as it is called, of the molecule and atom is a creative event, in that new elements are originated. It is presumed that the so-called fixed elements are the results of a past process of this kind, now however slowed up. From a simple substance presumably the complex has been born. From radium, on this basis, lead owes its origin, if the hints and deductions of science are to have any weight in the consideration of such vast problems as the cause of matter as we know it.

* * *

An Improvement in Wiring. The risks of fire and injury to wires have been receiving attention from many engineers interested in the development of safe electric wiring. The use of moulding, iron pipe and insulators for the protection of current-carrying wires, has at times been subjected to the criticism that, although safe, they represent only a form of protection that is not part of the wire itself. It has been suggested by some English specialists that great improvements would result if wires were lead-encased and made into twin conductors. The suggestion was based upon the idea that a pair of lead-covered wires could be readily installed. Where they are to be buried in plaster they could be quickly attached to the wooden joists generally found in walls or to the mortar foundation otherwise present. The burying of them in plaster could not affect their strength of position nor increase the fire risk to any marked extent. Such are the arguments advanced in favor of twin conductor lead-covered wires by our English friends; and it must be admitted that they are sound enough. But it is hardly necessary to remind them of the differences between our skyscrapers and their low office buildings. Feeders or risers supplying the upper floors, and in fact all floors, would occupy so great a space that the mere "burying in plaster idea" would not do. Pipe ducts are very convenient additions, not only because pipes are used but for the better reason that in this manner all conductors are accessible. It is a question whether it would ever pay to bury conductors, even such as are used in rooms, permanently in plaster.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The electrical exhibition to be held at Madison Square Garden in this city for two weeks, beginning December 12, will be formally opened by President Roosevelt, who, by the pressure of a button in the White House, will set in motion the machinery of the exhibition.

According to a report recently issued by one of this country's representatives in the Far East the opening out of Japan is likely to be followed by rapid development in China. This vast empire, with its enormous resources, kept in the background by the ancient superstitions and indolence of its inhabitants, cannot remain permanently invulnerable to the wave of regeneration which is sweeping over that section of the globe, and soon the country will be ready for the exploits of the electrician.

Several railway officials went on a short trip out of Philadelphia last Thursday to test a new electrical locomotive designed to replace the ordinary steam locomotive, especially on branches and spur lines. The new engine, which is capable of making 50 miles an hour, and which is of a peculiar type, is the invention of Lars Nelsen.

The Cunard Steamship Company, says the "Electrical Engineer," London, has already five of its North Atlantic steamers fitted with the submarine signaling apparatus, and it is understood that the "Carmania," the largest turbine-driven steamer in the world, and the first to run between Europe and the United States, will also be possessed of an equipment. Trials have been made on board the German steamer "Deutschland," from which the bell at the Outer Weser lightship was located at a distance of five nautical miles, while the noise made by the propeller of a large passing steamer was distinctly heard at a distance of 1½ miles, though the "Deutschland" was steaming 19 knots.

Porto Rico is now connected with Key West, Fla., by wireless telegraphy.

The pole line insulators on high tension transmission lines in California have to be protected, according to the "Canadian Electrical News." The natural deposition of moisture upon them in fogs, or of dust in dry weather, is apt to cause short-circuits, resulting in burning, and often destroying the pole. This is now prevented by sheltering all insulators by Λ-shaped boxes or sheds.

Americans are to equip the city of Quito, Ecuador, S. A., with an electric light and power plant.

Considerable use is made in Germany of electromagnets for lifting and transporting iron castings, etc., in workshops, says the "Electrician," London. The form of magnet employed varies with the kind of material to be lifted. For lifting objects with an uneven surface, for instance, electromagnets are used, the poles of which are capable of a certain movement so as to adapt themselves to the uneven surface. For lifting material of a thickness of at least 2 inches, the best magnet in all respects is said to be the "pot" type of electromagnet. If the object to be carried is long and narrow, it is usual to arrange a number of electromagnets side by side in a common shell, and for transporting sheet metal the magnet is provided with a number of poles in a cluster.

GERMAN APPARATUS FOR PREPARING FILAMENTS.

BY FRANK C. PERKINS.

The accompanying illustration, Fig. 1 and drawing Fig. 2, shows the construction and arrangement, as well as the electrical connections of an interesting German electrical equipment for preparing carbon filaments for incandescent lamps. This apparatus is constructed at Berlin by Ganz & Goldschmidt, and consists of a contact ammeter as noted in Fig. 1, together with a rheostat noted in the illustration, also at d, in Fig. 2, together with a direct reading ohm-meter and magnetic contact devices. The filaments are placed in a receptacle f, and connected with the current, the contact ammeter a being placed in the circuit, and the carbonized filaments are subjected to heavy hydro-carbons.

As well known the thinnest portions of the filaments become incandescent first, the solid carbon being deposited on their surface, owing to the reduction of the gas. As soon as a uniform section is produced throughout its entire length, the section will increase during the incandescence at a uniform rate. The current from the battery b, noted in Fig. 2, actuates the relay c, and the circuit is automatically opened by the contact ammeter interrupting the working circuit at e, this action occurring with a given maximum current intensity, which is characteristic for each cross-section of the filament.

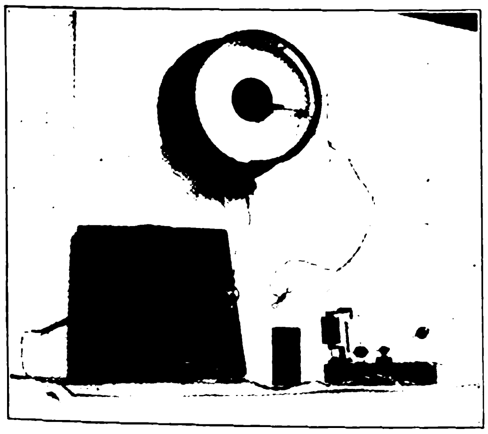


Fig. 1.

By adjusting the shunt resistance indicated in d, the sensitiveness of the apparatus may be varied for any desired thickness of filament, and it is stated that the diameter of the filament prepared by this apparatus will be accurate within 1 per cent. It is stated that this outfit is more suitable for preparing carbon filaments than the bridge process which is frequently employed, as it responds independently of the length of filament and lamp tension to a given cross-section of the filament and not to a given resistance of the filament, The rheostat is marked with indications, showing the current intensity at which the preparing current for the carbon filament is automatically interrupted, and it is stated that the apparatus is also divided into scale divisions, which give the diameters of the filaments, and by this means the outfit may be operated by attendants who are not particularly skilled in the art. The scale of the direct reading ohmmeter before mentioned is divided into diameters of filaments which makes it possible for the filaments which have been prepared to be checked as to their diameters one with another. It is claimed that even with an ohm-meter divided into ohms, sufficient accuracy is obained, and several hundred resistance measurements may be made each hour. This apparatus is of special interest to those engaged in the manufacture of incandescent lamps in the United States, showing as it does one of the unique German devices for preparing filaments.

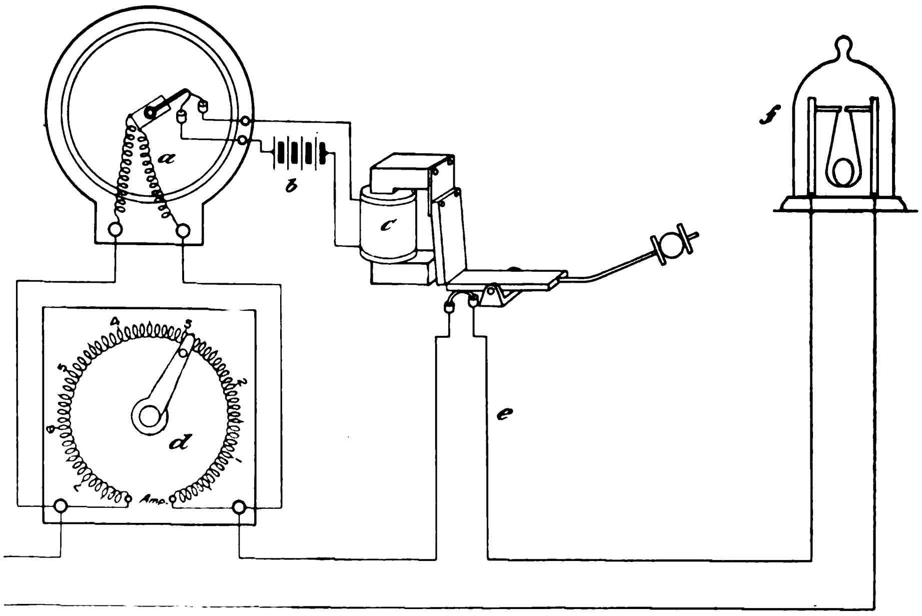
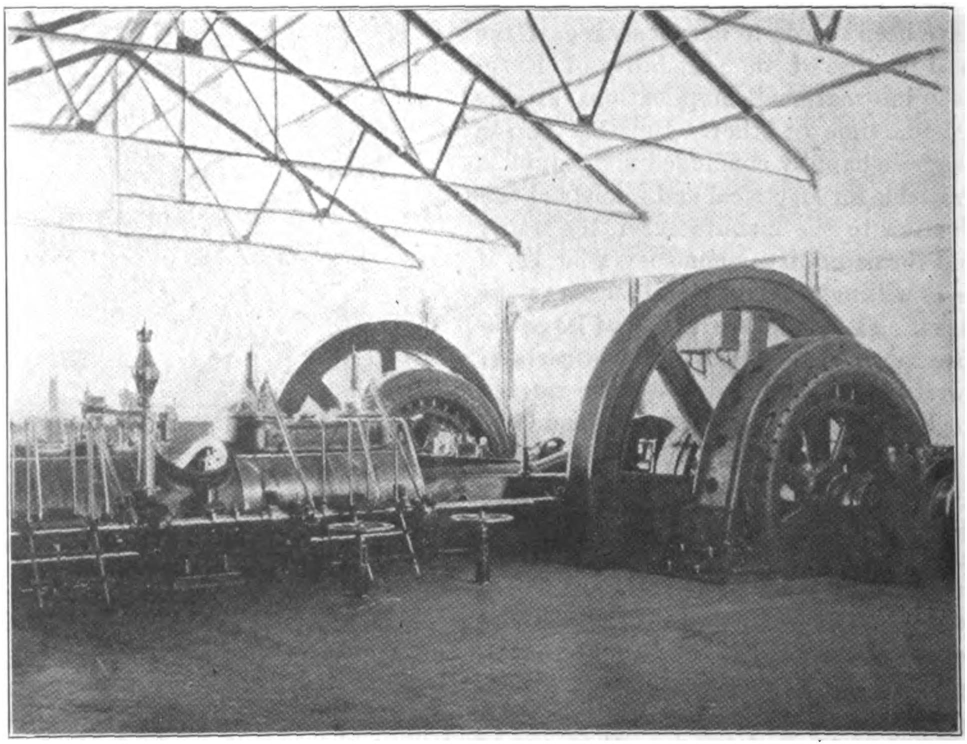


Fig. 2.

AN EGYPTIAN ELECTRIC RAILROAD.

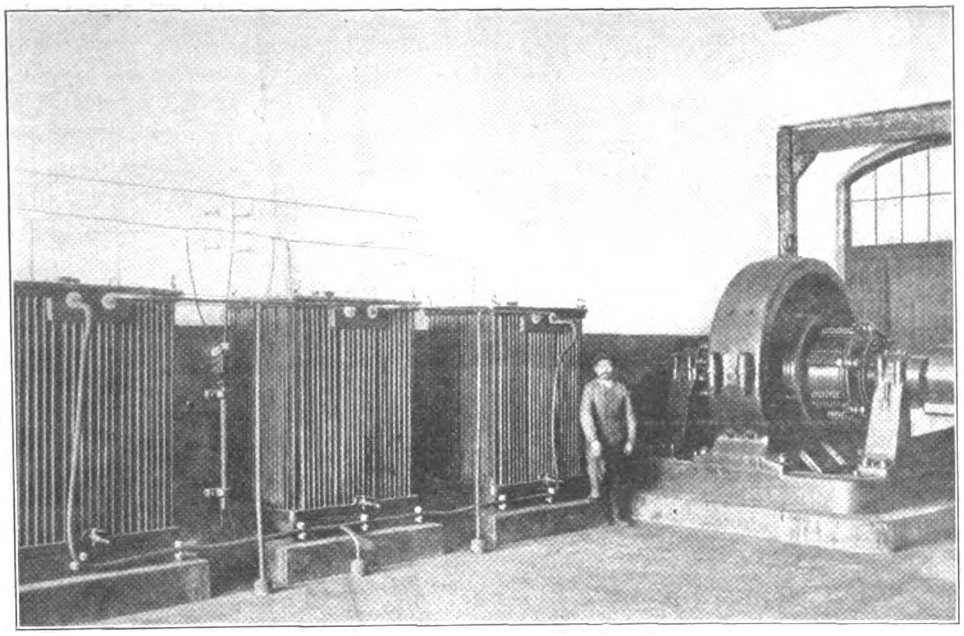
(From our London Correspondent.)

During the last decade electrical engineers, both European and American, have looked toward Egypt with a wondering business eye. On the part of none can it be said that there has ever been very great enthusiasm regarding the immedi-



Power House Alexandria Ramleh Railway.

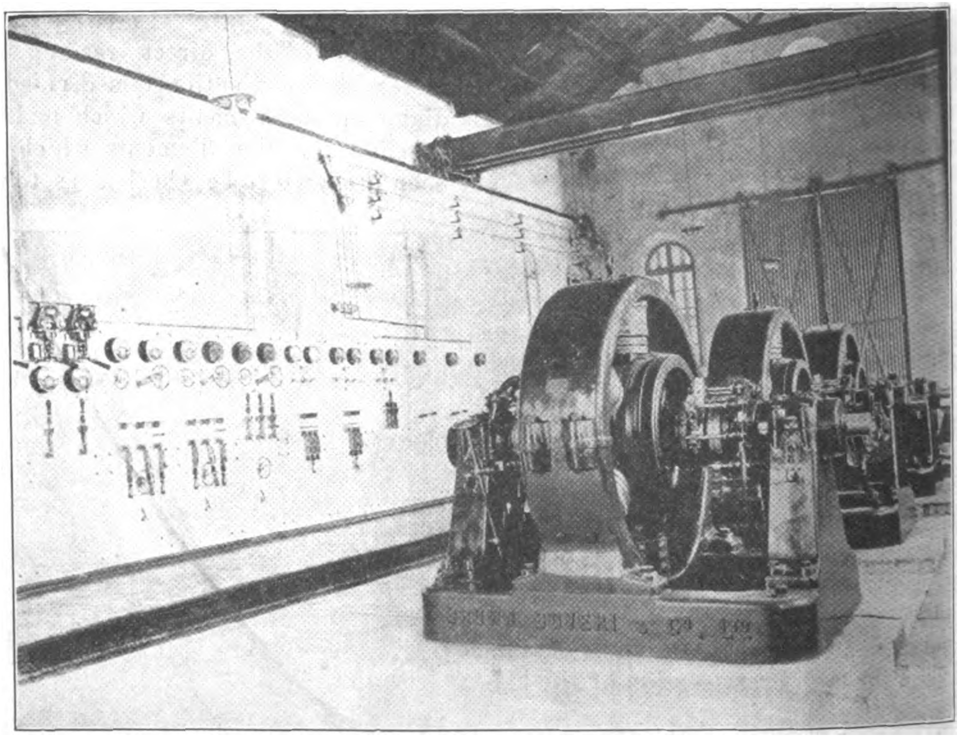
ate electrical trading possibilities. Many years ago a proposition by a leading English authority for the utilization of the great Nile Cataracts reached the Institution lecture stage, the cost of copper transmission lines for a long distance scheme and many like particulars being worked out according to the then known results of what then was regarded as long distance work. If we remember rightly, the Egyptian Government went so far as to have a report on the whole situation and future electrical transmission possibilities and their effect upon the general development of the land prepared by this same authority.



The 350 Kw. Converter and Transformers in Power Station.

This was in the days when there might have been reason to nervously regard the land because of the possibility of European international complications arising at some time or other. But that period has been happily concluded and Egypt is available for electrical and industrial cultivation to the manufacturer, the trader and the capitalist, whomsoever he be, if he is willing to lend his aid and bear the risks. That Egypt is a field of large future possibilities electrically is certain, but its immediate needs are being catered for by British, Swiss, American and German firms. It is only a short time ago that half-a-dozen of the important British makers of engines, dynamos, cables, etc., combined to jointly seek electrical business in Egypt.

Mention has been made of the proposal for the utilization of the Nile Cataracts, and with the more modern data that is now accumulating for expert application to that problem the accomplishment of this object for rendering vast lands, which are at present valueless, of considerable use and value, is almost in sight. Electric lighting and traction development are, however, taking place already in the more important towns, such as Port Said, Alexandria and Cairo. In some of these Belgian enterprise was responsible for the introduction of works and tramways, but control has now passed into Egyptian hands. The tramways of Alexandria are worked by the Alexandria & Ramleh Railway Company. The town lines were owned by the Societe Anonyme des Tramways de Alexandrie of Brussels, but these as well as the recently electrified connection between Alexandria and its eastern suburbs, are now both worked by the Alexandria & Ramleh Company.

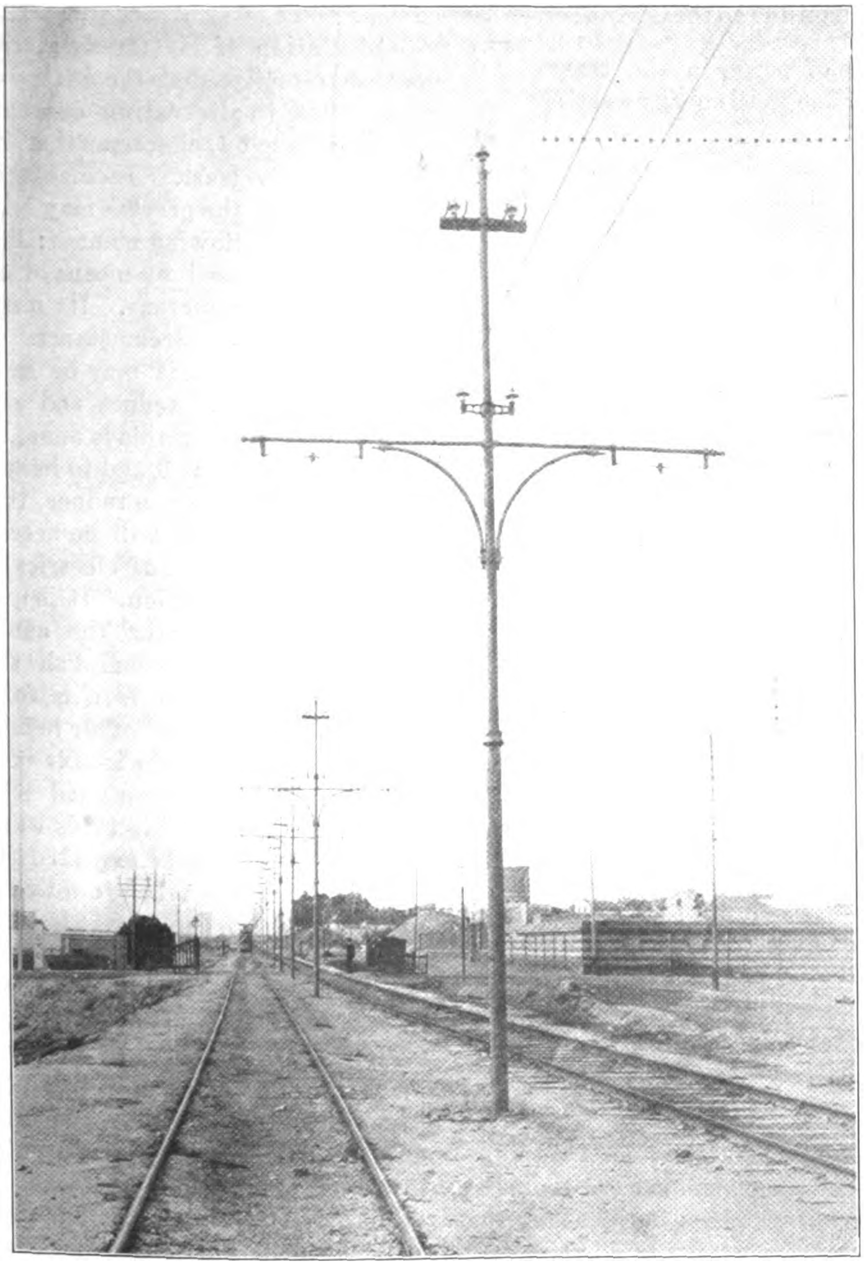


Bulkeley Sub-station.

In the accompanying illustrations are given some views of the Alexandria-Ramleh lines and their power equipment. Up to last year this line was operated by steam, but the continually increasing tourist traffic led the company to resolve upon some better method of locomotion, and a scheme was adopted which involved among other things the installation of two 600 kilowatt three-phase alternating current high tension generators of the revolving field type (speed 107 revolutions, pressure 6,500 volts, frequency 25 cycles per second) of Brown, Boveri & Co. of Baden. These have been erected at the Alexandria Company's central station, direct coupled to horizontal tandem steam engines by Tosi. There are ten Elephant type boilers (135 pounds per square inch) installed; they are hand-fired, use bituminous coal, and are equipped with Green's economizers and Worthington pumping plant. A transmission line has been erected connecting the central station to a sub-station near Bulkeley (half way between Alexandria and Ramleh). The three-phase high tension current is converted to low tension and then to continuous current by means of stationary and rotary transformers.

The magnet wheel of the alternators is not fixed on the shaft of the engine, but is connected to its fly-wheel by means of a flanged coupling. There are two 35 kw. continuous current machines for exciters. The switchboard is on the usual Brown-Boveri principle; two panels are for alternators, one for exciters and two for feeders. The high tension panels are provided with oil switches, and the feeder panels have overload circuit breakers for safeguarding the transmission line.

Current is led from the power station to the sub-station 10.5 km. away by two three-core cables. In order to avoid crossing the inhabited quarter with a high tension line two underground cables are laid for the first portion, and on the way to Ramleh connection is made with an ærial line. From this point the high tension feeders are carried to Bulkeley sub-station on the center poles of the system, which also carry the trolley brackets.



Overhead Three-phase 6,500 Volt Transmission Line.

A feature of this high tension line is the provision of grounding forks under each line wire upon both sides of each insulator, so that if a high voltage wire breaks it drops into the fork and is immediately grounded and rendered harmless.

The Bulkeley sub-station is situated in the center of Ramleh, about eight miles from the power plant, and it contains three three-phase transformer sets, each set consisting of three single-phase static transformers of 110 kw. connected up in delta and designed to reduce the tension from 6,500 to 350 volts. The transformers receive the current from the high tension bus-bars through three oil switches. The alternating current at 350 volts is led to three rotary converters which convert it into a 560-volt continuous current. Each converter is of 300 kw. capacity at 500 revs. per min. This arrangement dispenses with bus-bars for the low tension alternating current and greatly simplifies the wiring and manipulation of the board. The converters are started from the continuous current side, current for this purpose being generated by a 50 hp. asynchronous continuous current motor generating set. The rotary can also be brought up to synchronism by admitting the secondary current from the transformer direct on to the armature and closing the exciting circuit, as usual. Besides the shunt winding these converters are provided with two compound windings which can be put in series or in parallel, the object being to obtain, in conjunction with choking coils in the alternate current circuit, a tension variation from 500 volts at no load up to 525 volts at full load, with compound windings in series.

The four feeders from this sub-station are for four sections thus: Alexandria up to Bulkeley; Bulkeley down to Alexandria; Bulkeley to S. Stefano along the old track; from Bulkeley to S. Stefano along the new line.

Each first-class motor-car has a trailer for second-class passengers. They are of European double-deck type.

It ought to be added that at the central station a 350 kw. converter has also been installed to work in parallel with the continuous current machines for supplying the town tramway service; it also re-converts from continuous to alternating current when the small load on the sub-station renders it uneconomical to have the 600 kw. group working.

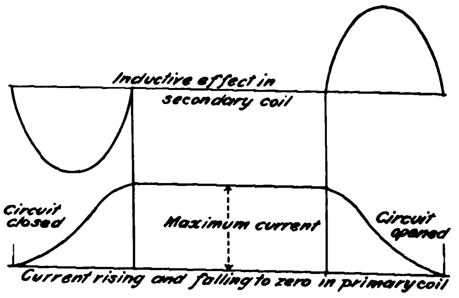
It is understood that the change over of this line to electric traction increased the traffic by some 33⅓ per cent. in a very few months.

* * *

LIGHT, HEAT AND POWER PRINCIPLES.—X.

BY NEWTON HARRISON, E. E.

Mutual and Self Induction.—Both inductions are caused by the interlinking of lines of force with the turns of wire. The transformer is peculiarly representative of a case where mutual induction occurs between the primary and secondary coils, and self induction in each coil individually. An illustration, showing the self-inductive relationship in any coil when current is introduced, to the current due to the impressed EMF., will serve to emphasize the true meaning of this phenomenon. It is not essentially different when an alternating current is introduced, except in so far as it represents more complications, because of the rise and fall to zero of the current in one direction, and its rise and fall to zero in the opposite direction. The influence op-


Inductive effect in secondary coil
Circuit closed
Maximum current
Circuit opened
Current rising and falling to zero in primary coil

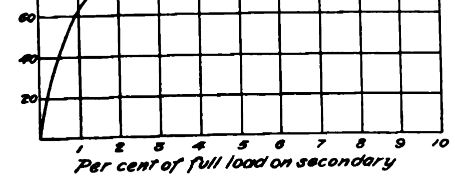
Action of a primary on a secondary coil.

erating is always reactive. By this is meant, that when the current attempts to grow in strength the reaction grows likewise. Whereas, on the other hand, when the current tends to decrease in strength, the reaction is reversed. It then strengthens the current as it tends to diminish, sustaining it, beyond its normal time, and causing the flash or kick to appear when the circuit is broken.

The entire process is due to the effect of a variation in the lines of force when the current is either increasing or diminishing. In a transformer the inductance is three-fold in the sense that both self and mutual inductance occur in the two coils as follows: 1st—Self-induction in the primary due to the increasing and diminishing current. 2d—Mutual induction between the primary and secondary. 3d—Self-induction in the secondary coil. The correct impression is best conveyed by the realization of the magnetic relationship between the coils when a core of iron of a continuous character permits the lines of force to freely operate upon both. The commercial value of the self-induction is found in its automatic regulation both of the energy entering the primary and the energy developing in the secondary. The mutual inductance between the primary and secondary is one henry, when the number of lines of force from the primary coil due to one ampere which interlinks the secondary coil, are equal to one hundred million. Or this may be stated by saying that "The mutual inductance of two coils is one henry when the passage of one ampere through one coil causes a total magnetic flux of 10^8 lines of force to be linked with the secondary coil."

The Transformer Iron.—Losses of power in the iron represent the exact amount of power wasted in eddy currents and hysteresis. Using a very high grade of soft iron of little coercive force will reduce the hysteresis, as this is entirely a molecular affair. But eddy currents are only reduced by laminating the iron; that is, using it in the form of thin sheets. The efficiency of a transformer is greatly dependent upon the character of its design in this respect. Such design is best obtained by the use of iron of the lowest coercive force and the highest permeability. For instance, if a transformer dissipates 500 watts out of 5,000, then the efficiency equals 4,500 ÷ 5,000 = 90 per cent. But the 500 watts wasted may be regarded as consisting of the following:

Loss of power in watts in the iron core due to eddy currents and hysteresis.................... = 150
Loss of power in watts in the primary coil due to the C^2R effect. = 150
Loss of power in watts in the secondary coil due to the C^2R effect. = 200
Total loss of power in the transformer due to all energy wasting causes........................ = 500



Efficiency curve of a transformer with various loads.

The Permeability of Iron.—The permeability of the iron employed is of such importance that an exact knowledge is required of the figures by which it is represented. In the following table the magnetizing force required and the permeability of sheet steel and annealed soft iron are given:

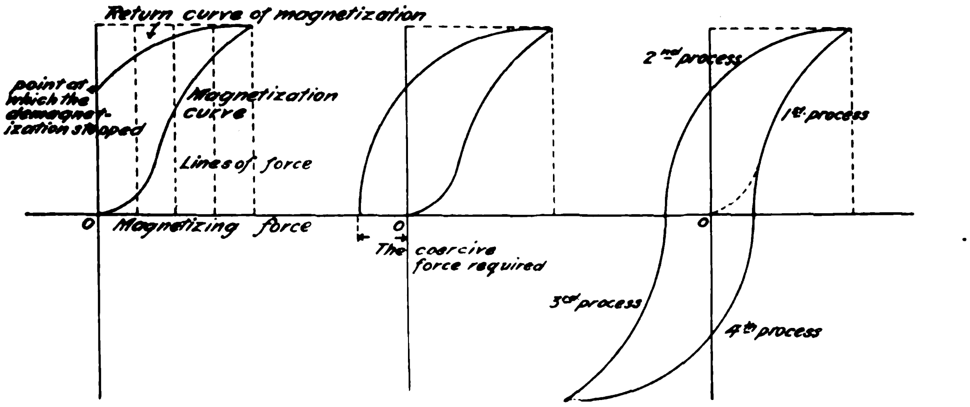
Magnetization Data of Mild Annealed Steel and Soft Swedish Iron at About 60 degs. Fahrenheit.

Lines of force per sq. centimeter.	Magnetizing force H required for		Permeability μ for	
	Annealed cast sheet steel....	Annealed soft iron.	Annealed cast sheet steel....	Annealed soft iron.
2,000	1.2	0.8	1,800	2,675
4,000	1.7	1.17	2,400	3,375
6,000	2.5	1.73	2,425	3,500
8,000	3.7	2.55	2,150	3,150
10,000	5·55	3.95	1,800	2,550
12,000	8.95	6.45	1,375	1,850
14,000	15.00	12.00	950	1,050
16,000	29.00	54.00	550	325
18,000	90,00	126.00	200	125
20,000	224.00	324.00	87	55

The act of magnetization is accompanied by certain phenomena as noted in the following synopsis: 1st—The fact that with a small magnetizing force, a comparatively large magnetic change takes place in the iron. This has been called by some authors the elastic stage. 2d—The fact that with a small additional force when a certain point in magnetization is reached, a comparatively complete magnetization takes place. This has been called by Fleming the catastrophic stage. 3d—The fact that with a great increase in the magnetizing force a very limited response occurs magnetically in the iron. To reverse this operation necessarily represents the absorption of power. This power, it seems, disappears in the effort to return the iron to its normal condition, and then reappears as heat. The iron will when heated, respond more readily to small magnetizing forces. Its permeability under this condition is increased. The entire action is that of the molecules of iron attracting each other so strongly that a certain amount of force is required not only to break this attraction as it normally occurs and rearrange them; but it is also required to bring them back to where they started from.

Calculation of Hysteresis in Iron.—It is best to realize that the quality of iron best suited to alternating current work, is iron of such a character that its coercive force is least. In magnetizing a piece of iron, the process may be considered in the following manner: First, the iron is magnetized by means of a coil of wire carrying a current. Its magnetization under such circumstances may be very high, in fact it may be saturated. The next step is to reduce and withdraw the current. When this is done, the iron if examined will be found to be still magnetized. In order to reduce this magnetization to zero, it will be necessary to use a certain amount of electrical energy in the reverse direction. It is quite evident that the greater the amount of energy required to accomplish this, the poorer the quality of iron is for transformer use. On the other hand, if the demagnetization of the iron is continued in the opposite direction until it reaches a point equally as high this way as the other, it is only to be expected that the same process must be followed out to bring it back to zero again. If, for instance, during the magnetization of the iron up to a certain point and its return to zero, five watts are consumed; then it would require five watts to reverse its magnetization up to the same point and back. The total during the entire operation would therefore be 5 + 5 = 10 watts loss. This complete operation is called a cycle of magnetization, and is due to the effect of a complete cycle of current in a coil upon a core of iron. If the cycles are 100 per second, the watts wasted in the iron would be 10 × 100 = 1,000 per second. It is readily seen that the further the magnetization is pushed the more difficult it is to reverse and complete the cycle without a comparatively great loss of power. But it is also evident that the quality of the iron, through which it absorbs energy, is the feature which regulates its value as to its use in transformer construction.

Permeability and Coercive Force.—The facts as thus presented, mark the difference between the permeability of the iron and the degree to which it absorbs energy during magnetization and demagnetization. Although iron may have a very high permeability, it does not necessarily follow that the coercive force required is therefore very low. This important point is represented by means of a diagrammatic sketch in which the magnetization of a piece of iron is represented with the return curve showing the extent to which the iron returns to its neutral condition. The greater the distance between the return curve and the zero point, the more the likelihood exists of the iron absorbing energy. These ideas are presented in the form of a series of sketches which show the retentiveness of the iron, the degree of coerciveness in the iron, and the processes involved in a complete cycle of magnetization.


Return curve of magnetization
point at which the demagnetization stopped
Magnetization curve
Lines of force
0
Magnetizing force
0
The coercive force required
2nd process
1st process
0
3rd process
4th process

The retentiveness of the iron illustrated.

Diagram showing the coercive force required to bring the iron back to zero.

The processes involved in a complete magnetic cycle.

Formula for Hysteresis.—Steinmetz investigated the relationship existing between a certain grade of iron and the amount of energy it absorbs. The examination of a variety of kinds of iron clearly indicated that the energy was absorbed in strict proportion to certain elements which were best considered in the shape of a formula as follows:

Hysteresis in ergs = a constant × (lines of force per square centimeter)$^{1 \cdot 6}$.

If the formula is represented symbolically the following values appear: H = ergs, B = lines of force per sq. cm., constant = .002, the formula then becomes: Hysteresis in ergs = .002 × $B^{1 \cdot 6}$. The reason why .002 is selected is because an examination of the various metals disclosed the following figures:

Hysteresis Constants for Various Grades of Iron.

Names of metal.	Constant.
Swedish wrought iron well annealed	.0010 to .0017
Annealed cast steel of good quality with little carbon	.0017 to .0029
Cast Siemens-Martin steel,	.0019 to .0028
Cast steel with plenty of carbon and wrought iron of poor grades	.0031 to .0054

The number of lines of force per square centimeter, raised to the 1.6 power, may try the ability and patience of readers, so Fleming's figures are given for iron magnetized from 1,000 to 10,000 lines of force per cubic centimeter. In addition the total value of the product of the constant and the lines per square centimeter given raised to the 1.6 power are presented. The results are given in ergs per cubic centimeter, but the ergs are easily transformed into foot pounds or watts if required. The last line of figures in the table, giving the ergs absorbed by a cubic centimeter of iron carrying 10,000 lines of force, according to the formula, would be equal to about 10 foot pounds per complete cycle of magnetization.

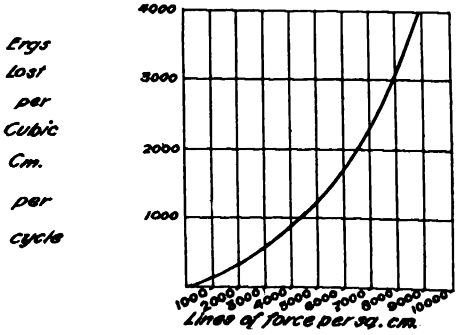
Table of Hysteresis Calculated by the Formula.

Lines of force per sq. cm.	Value of $B^{1 \cdot 6}$.	Value of .002 × $B^{1 \cdot 6}$.
1,000	63,100	126
2,000	191,300	383
3,000	365,900	732
4,000	580,000	1,160
5,000	828,800	1,658
6,000	1,111,000	2,222
7,000	1,420,000	2,840
8,000	1,758,000	3,516
9,000	2,122,000	4,244
10,000	2,511,000	5,022

As there are 10^7 ergs to a watt, it is evident the above table can be converted to English measure and watts if necessary. To illustrate the application of this table, consider the frequency of a commercial circuit carrying an alternating current as equal to 120 cycles per second. If the degree of magnetization is equal to 10,000 lines of force per square centimeter it will be equal to 6¼ × 10,000 or 62,500 lines of force per square inch. According to the table .002 × $10.000^{1 \cdot 6}$ = 5,022 ergs per cubic centimeter per cycle. This would mean 120 × 5,022 = 602,640 ergs; but as 10^7 ergs equal one watt, 602,640 ergs ÷ 10^7 or 10,000,000 will be equal to .06 of a watt per cubic centimeter. A cubic inch of iron is equal to 15.625 cubic centimeters, which would mean 15.625 × .06 watt per cubic inch, a value equal to .9375 watt. Averaging 1 watt per cubic inch would mean at this magnetization 1,728 watts per cubic foot of iron.

Choice of Iron.—The choice of iron for the various purposes to which it is best suited is found by an examination of the area of the hysteresis curve representing a complete magnetic cycle. As shown, the area must be large if a permanent magnet is to be constructed. On the other hand, the area is smaller where such iron is used for dynamo work. If transformer iron is to be selected the area is smaller still; in fact it must be small or the hystereis loss will be so great as to destroy the efficiency of operation of the transformer. The entire question of transformer design is related to the final question of lighting and power efficiency. To transmit electrical energy over a distance of many miles with economy it is necessary to limit the initial expense. This expense is divided up between the cost of the generating and receiving stations at each end and the investment required for the construction of the line. But the most important feature of this system is that of the transformation of the pressure up and down at each end of the power line.

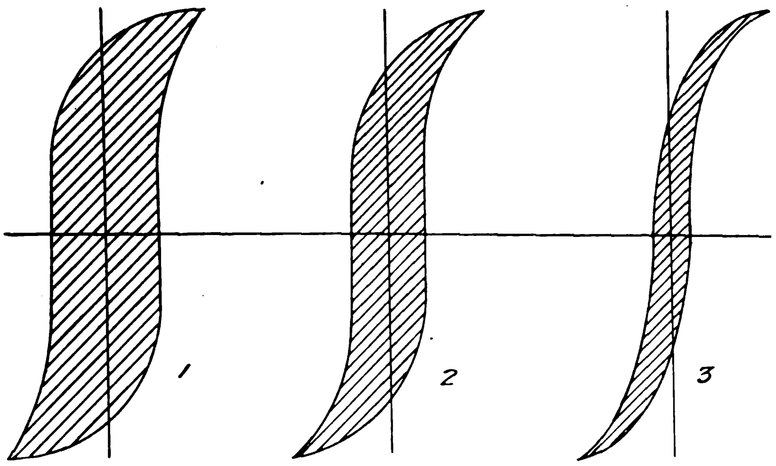
Curve of Hysteresis Loss.—Steinmetz constructed what is called the hysteresis curve in contradistinction to the hysteresis loops. The curve shows the relationship between the loss in ergs in the iron and the number of lines of force for a single cycle. The drift of the curve shows clearly the manner in which the losses in the iron grow with the increase in the magnetization. As long as the magnetization lies between zero and 5,000 lines of force the loss in ergs is slow in increasing. After passing this point, however, the rise is more rapid, and after the loss in ergs per cubic centimeter ex-



Steinmetz Curve of Hysteresis.

ceeds 2,000 the further loss increases rapidly. Dividing ergs by 10,000,000 or 10^7 will give watts; it is therfore a simple process in the calculation of hysteresis to judge of the relative value of different grades of iron by this means of comparison.

Principles of Design.—Not only in transformers, but in the armatures of direct current dynamos and in the moving iron parts of many alternators hysteresis occurs. The checking of it is one of the purposes of scientific investigation as well as the limitation of other sources of loss. With regard to transformers, the following conditions must be observed:



1—Area of curve large; metal suited to make permanent magnets. 2—Area of curve smaller; metal suited for dynamo magnets. 3—Area of curve very small; iron good for transformer construction.

First—The iron core loss must not represent more than 3 to 4 or if possible 1 to 2 per cent. of the total load in watts. One per cent. is not too high for large transformers of many kilowatts.

Second—The drop in volts in the secondary must not be more than 1 or 2 per cent. of the total secondary pressure.

Third—The core must be kept cool by allowing at least 3 to 4 square inches of radiating surface per watt wasted in the iron.

Fourth—The winding of both primary and secondary coils must be large enough to radiate the heat they generate through C^2R loss. An allowance of from 2 to 3 square inches per watt wasted must be provided in the coil surface.

Fifth—Insulation of the best quality is necessary to withstand high pressures.

Sixth—Additional ventilation and cooling must be supplied to keep down the temperature of large transformers. Air blasts and oil are the favorite methods in vogue at present.

The recent electrical exhibition in London was such a financial success that the executive committee has been able to refund to the exhibitors much of the money they paid for space.

ELECTRIC FURNACES.[*]

BY J. H. STANSBIE, B.SC., F.I.C.

The main object of this paper is to introduce to you simple forms of electric furnaces which can be readily fitted up for experimental purposes. The literature of the subject is rapidly becoming voluminous, especially that which refers to the specifications of patents. Every known principle seems to have been appropriated in the hope that something useful may be covered, but in spite of its many successes the application of the electric furnace for industrial purposes is still in its infancy, and there is much hope for its future.

Electric energy may be converted into heat in a variety of ways, and the chief of these have been utilized for electric furnace work. Electric furnaces may be divided into two main classes: First, electro-thermic, in which the heat equivalent only of the electric energy passing into the furnace is utilized for producing physical, chemical and metallurgical changes; second, electrolytic, in which part of the energy of the current is used up directly in effecting chemical changes, and the remainder for heating effects. The first class only will be dealt with in this paper.

There is only one direct way of converting electrical energy into heat, and that is by putting material resistance into the path of the current which is carrying it. This resistance may be furnished by either a solid, a liquid or a gas. If the resistance is offered by solid or liquid matter the apparatus is known as a resistance furnace, but if by gaseous matter it is an arc furnace. A large number of furnaces, both experimental and industrial, arrange themselves under these heads, and there are several sub-divisions according to the particular way in which the principles are applied. In the majority of these furnaces the resistance is in the path of the primary current. There is, however, a resistance furnace in use which does not appear to have passed through the laboratory stage, but to have been developed at once for industrial purposes. It is based upon the transformer principle, and consists of a cored coil for carrying light alternating currents of high potential surrounded by an annular space or hearth lined with refractory material in which a continuous circuit of the metal under treatment carries the heavy induced currents of low potential, and offers the resistance necessary to develop sufficient heat for its fusion. Its best known form is the Kjellin furnace, although others claim to have introduced important modifications. Kjellin uses currents of 80 to 90 amperes at a pressure of 3,000 volts in the primary, and 30,000 amperes at seven volts in the ring of metal in the hearth, which has a capacity of 35 cwt. of steel. Furnaces of this type having a capacity of a few pounds should prove very valuable for the preparation of pure metals.

In resistance furnaces generally the resistance is either in or out of contact with the material to be heated, or the material itself offers the resistance. Also, either direct or alternating currents may be used, the most economical being heavy currents of low pressure. Hence it is necessary to use transformers with alternating currents brought from a distant power station. The terminals by which the current is led into and out of the furnace are almost invariably carbon rods or blocks, although water-cooled metal electrodes have been used. In some furnaces a combination of arc and liquid or solid resistance is found most useful, and in this case the pressure must not be too low.

At present the ideal source of the mechanical energy for dynamos and alternators is water power, and where this can be obtained the electric furnace flourishes. The enormous loss of energy taking place between the stoker's shovel and the fly-wheel of an engine puts the direct combustion of solid fuel out of court, but the use of gaseous fuel direct, especially of the waste gas from blast furnaces, will much improve the chances of electro-thermic processes being made successful generally. It is estimated that about 500,000 hp. developed from falling water is being used in electric furnaces for the production of aluminum, carborundum, calcium carbide, graphite, iron, steel, ferro-alloys, etc. The Acheson furnace for carborundum, the Heroult furnace for steel-making, the Stassan furnace for ore reduction, and the Keller furnaces may be mentioned as being in use in successful industrial processes, while the number of furnaces being used for the manufacture of calcium carbide is very large.

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[*] Abstract of paper read before the Birmingham (Eng.) Electric Club, November 4, 1905.

Experimental Furnaces.—A small resistance furnace for demonstrating the melting of metals is readily made by chipping the large face of a firebrick so as to form the cavity and two semi-circular channels running from it to the ends of the brick. A second brick with a shallower cavity and similar channels serves for the top. The cavity forms the hearth of the furnace, and the channels allow of the introduction of two carbon rods which are fixed with their ends just projecting into the cavity. The metal is placed in the cavity, and covered with a layer of small pieces of carbon so arranged as to fill up the space between the carbon rods. (Arc carbons broken up serve the purpose very well.) The top is placed in position and the current switched on. The temperature rises rapidly and a charge of cast-iron is soon melted. This can be run from an inclined tap hole passing through the bottom of the cavity by plugging the upper end with a piece of the metal before charging. The metal plug melts last, and the whole charge runs from the furnace in a continuous stream. A vertical section of the furnace is shown in Fig. 1. A slight modification of this furnace enables it to be used with a carbon tube. For this purpose an inclined channel is made in the walls of the hearth at right angles to the length of the bricks to hold the tube, the ends of which project from the sides of the furnace. The cavity is filled with carbon fragments to surround the tube and connect the rods. On passing the current into the furnace a rapid increase in temperature takes place, and substances to be experimented with can be readily introduced into the tube. Reductions and fusions are rapidly effected. The tubes are easily made by drilling pieces of arc carbon of requisite length. See Fig. 2, which shows the furnace in vertical transverse section.

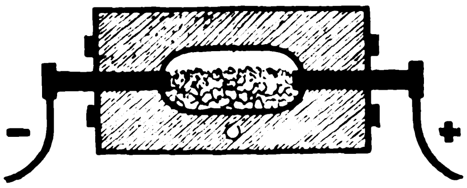

FIG. 1.

A small arc furnace of the Siemens type is easily fitted up. A hole is drilled in the side of a carbon crucible, and a carbon rod fitted tightly into it. The crucible is placed in a cavity in a fireclay block, which also supports the carbon rod along part of its length. The block is placed on a small iron table having a vertical rack motion, and a carbon rod to act as the positive electrode is fixed vertically over the crucible. When the charge has been introduced and the current switched on, the arc is readily struck by raising and lowering the table. The operation can be regulated by the same means. Fig. 3 shows the furnace in vertical section.

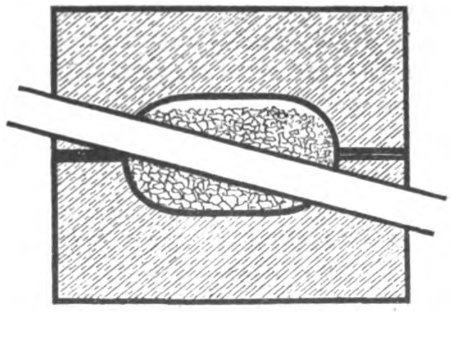

FIG. 2.

A more durable form of the Moissan lime furnace can be made with strongly compressed magnesite bricks. Two of the bricks are chipped out on corresponding faces, so as to form the crucible cavity and the channels for the carbon rods. They are then braced firmly together, and the top formed by a third brick, hollowed out a little to correspond to the cavity below. The electrodes are carbon rods, 1 inch diameter and 15 inches long, having a copper electro deposited on part of their length to insure good contact. The reactions are carried out in a shallow carbon crucible, and the majority of the fusion and reduction experiments requiring very high temperatures can be made in it. Chromium and molybdenum are readily reduced from their oxides. The current used in these furnaces varies from 100 to 200 amperes at a pressure of 110 volts in the mains.

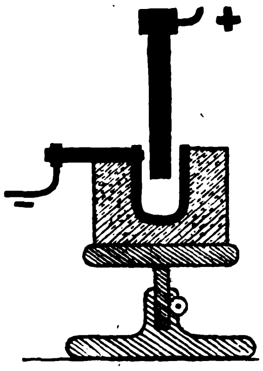

FIG. 3.

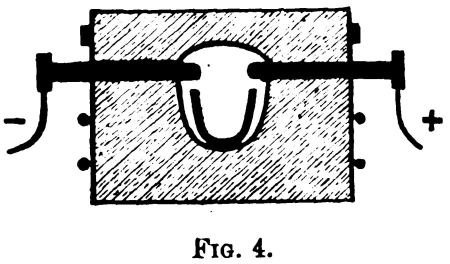

FIG. 4.

A good idea of the interest taken in electric smelting by those who are in position to deal with the subject practically, can be obtained from a review by M. Minet in the "Electro-Chemist and Metallurgist" for December, 1904. No less than 260 references, exending from Davy's work with the alkalies in 1808 to the present day, are given, and some 40 of these refer to calcium carbide alone. This shows that much attention is being given to reactions which take place at exceptionally high temperatures, and for the elucidation of which M. Moissan has done so much. One of the latest developments is that dealing with tantalum, the cheap production of which bids fair to mark an epoch in the history of incandescent lighting.

LEAD-COVERED WIRING.*

BY JOHN D. MACKENZIE.

The wiring problem—like the poor—we have always with us—either in the description of a new system or the acclaiming or declaiming of an old one. But of all the various systems—and they are legion—lead-covered wiring is, perhaps, the one on which we have the greatest diversity of opinion, the advocates of the system being quite as dogmatic in their support of it as its opponents are in denouncing it. Yet really, when all is said and done, there is no system of electric wiring which can be regarded as a universal panacea for the ills that electric wiring is heir to, and so finally, it comes to be a case of adjustment of pros and cons in order to decide which system is the best for each particular instance. If wiring contractors and consulting and municipal engineers could study each case absolutely on its merits, without any predisposition or bias, and recommend the system best suited to meet all the circumstances, the quality and durability of electrical installations, as a whole, would be instantly put on a higher level than it is at present.

In the following remarks I shall endeavor to place the advantages and disadvantages of lead-covered wiring side by side, and show how some of the disadvantages may be minimized.

Advantages.—1. The wire comes to the contractor, already provided with its own continuous metallic sheathing, and generally requires no further protection.

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*From the "Electrical Review," London.

2. The sheathing is water-tight, and the whole installation can quite readily be made so too.

3. The great flexibility of the wire enables it to be installed with much less damage to buildings.

4. The small diameter of the wire enables it to be used in surface work, where any other system would be an eyesore.

5. The difficulty of making joints practically compels the adoption of a loop-in system.

The disadvantages urged against the system are many and various, but fall under two general heads, viz.:

1. Risk of injury during erection.
2. Risk of injury after erection.

To that, some add the risk of injury during manufacture. This, however, with the exception of one point, is no greater in lead-covered than in the ordinary taped and braided wiring. The one point of difference is in the heating to which the wires are subjected during the process of sheathing. Considering, however, the rapidity with which the wires are run through the lead press, and the tests which are afterward applied to these cables, and which they successfully stand the risk of damage seems very slight.

Before dealing more fully with the disadvantages attendant on the use of lead-covered wires, it may be as well to point out that, personally, I have no love for twin wires, either round or flat, considering it inadvisable, to say the least, to run the chance of an internal short-circuit inside a soft metal sheathing. It is far preferable to use single lead-covered wires, with the lead sheathing properly bonded and earthed, because it then requires two "earths" one on each wire before one obtains a short-circuit, and on public supply systems an "earth" on the live wire means the blowing of a fuse. For these reasons, I do not intend to deal here with twin wires.

The risks of injury during erection, arise from the carelessness of the wireman, and from the carelesness of other workmen.

The careless wireman cuts into the insulation when stripping off the lead sheathing; overheats and softens the insulation when sweating the sheathing into boxes for a water-tight system; overlooks the pin-holes caused by heated air bursting through the melted solder at such boxes; pulls the lead sheathing too hard, so making it brittle, and then it cracks when bent: hammers on his saddles too tight, and perhaps puts them on twisted, so cutting the lead by the edge of the saddle.

The carelessness of other workmen is shown—by the the plasterer who cuts the lead with his trowel; the laborer who drops a shovel on it; the joiner who nails the flooring board to it; and by any man who walks with hobnailed boots over the top of it.

The risks after erection are:

(a) The lead gives very little mechanical protection, from nails, for example.

(b) It may be successfully attacked by rats and mice.

(c) If a failure of insulation takes place, a wire cannot readily be withdrawn and replaced.

(d) Lead expands with increase of temperature, and may not go back to its original length when cold, and hence it may come in contact with other metals, or may even get cracked and broken.

(e) The electrical resistance of lead being high, contact with other metals may form a better "earth" than the proper earth connection.

(f) When an "earth" comes on, the lead may fuse at the point of contact as quickly as the fuse wire does.

(g) Pure water in the presence of air, and water containing salts in solution, such as ammonia, have a solvent action on lead.

(h) Decaying animal or vegetable matter under floors, etc., produce acetic acid, which, acting on the lead sheathing, has also a deleterious effect by forming "white lead."

(i) The presence of other metals, such as brass saddles in damp situations, causes electrolytic action.

(j) Where the lead sheathing is bared back to allow the wire to enter a switch or other fixture, there is a tendency for the current to creep on to the lead and escape at some other point, causing electrolytic corrosion.

The above list of defects, disadvantages, and possible risks of injury follows, with some variations, a very full arraignment of lead-covered wires, and I take it to represent all, or nearly all, that can be said against the system.

The next point which arises is the question, "Is it possible to overcome or minimize the risks?"

Taking the careless wireman, it is quite possible to get careful workmen who will do none of these things; and, in any case, will a careless workman not cut into the insulation when removing braiding from ordinary wire—will he not twist and kink the wire when drawing it into conduit, will he not leave ragged edges on his conduit so as to tear the insulation, will he not attempt to draw too many wires into a conduit, so straining the insulation and breaking the strands of wires; in short, what will the careless wireman not do? Ergo, get rid of him as quickly as you can.

The risk of injury from other tradesmen is always present, and where lead-covered wiring has to be carried out while a building is in course of erection, special precautions must be taken to avoid injury—e.g., laying temporary boarding over the runs of wire on the floors, lapping up with tape where coming out through plaster work, etc.

The faults after erection make the most formidable list, but it is quite possible to minimize these considerably.

(a) This point is made a good deal of by the opponents of lead-covered wiring, but seems to me to be grossly exaggerated. During the last seven years I have only had three instances in which lead wiring was damaged through nails or similar articles having been driven through the plaster work.

(b) This again is much exaggerated. Rats and mice have teeth which can easily work havoc on lead wire, but they seldom do so, and my own personal experience supplies no instance. These rodents will only attack lead wiring or lead water-pipes when in the direst straits for food or drink.

(c) This is the only point where conduit systems can show any real superiority over the lead-covered. The usual method of lead-covered wiring is to plaster it right in, and consequently it is impossible to withdraw it without damage to the plaster work. Several years ago the writer adopted the system of putting thin close-joint tubing in such walls as would be plastered up solid, dropping the lead-covered wires down this tube and drawing them taut, then placing an insulating bush top and bottom of tube, thus giving the advantage of a conduit system and also some more protection against an exploring nail.

(d) Here we have a fault not so much due to the lead-covered wire as to its indiscriminate use. Where wiring is to be subjected to very great variations in temperature, lead should not be be used, but the writer has never found the ordinary temperature changes in house or shop to have any appreciable effect on the lead sheathing.

(e) In order to overcome this all that is necessary is to bond all the lead wires together at frequent intervals, and so get the advantage of all the sheathing. For this purpose the writer uses a solder containing a large proportion of lead, and has found no trace of electrolytic action even in damp situations after years of use.

(f) The foregoing method of bonding the wires together tends to prevent the lead sheathing melting before the fuse does.

(g and h) The solvent effects of water with either air or salts in solution are certainly a possible disadvantage, but no more so than with thin enameled conduits, which rust through in a very short time. Except under very exceptional circumstances, the amount of acetic acid which can be formed by decaying matter will not seriously harm the average lead-covered wire,

(i) Electrolytic action between brass saddles and the lead sheathing may quite easily be overcome by the use of lead saddles, which are quite as efficient.

(j) The current creeping along the insulation and on to the sheathing and causing electrolytic corrosion, is also easily overcome by dipping the ends of the wires up to the sheathing in melted joint-box compound. This also helps to increase the insulation resistance of the whole job.

The faults which so often occur on lead-covered wiring are all due to carelessness in the workmen, or because the conditions under which the wire is to work have not been properly appreciated. And the advantages to be obtained by the use of lead-covered wire makes it easily worth the time spent in considering all the necessary circumstances. An example of what not to do was given a good many months ago in a letter published in these columns, where lead-coverd wire has been drawn into the iron gas pipes laid in the ground, with the inevitable result, viz., breakdown.

Here the lead covering was no doubt scratched, and perhaps cut while being drawn in, by the roughnesses inside the tube and then it lay touching the iron and perhaps surrounded by moisture, either leaking in through the pipe joints or due to condensation inside the tube, thus giving the very best chance for electrolytic action.

No one knowing the limitations of lead-covered wire would suggest or carry out such an arrangement, instead of which the wire ought to have been laid either in wood troughing and pitched in solid, or drawn into smooth earthenware or concrete conduits. It is the adoption of such obviously foolish arrangements, as indicated, which has given lead-covered wiring a name for want of reliability, and I trust the foregoing remarks may indicate, in some small measure, how to overcome some of the difficulties.

General Electric's New Stock.

The directors of the General Electric Company decided to recommend the issue of a little more than half of the $11,674,500 increased capital stock authorized at a meeting of the stockholders on November 1 last. The amount to be issued is $6,033,000, and the stock will be offered to stockholders for subscription at par to the extent of 12½ per cent. of their present holdings. This would amount to about one share of new stock for every eight shares of existing capital.

The special meeting of the stockholders to ratify the issue of $6,033,000 new stock, well be held at Schenectady, December 5. Further details as to the date of the new issue, and the time and manner in which payment will be required to be made will be announced shortly after that meeting.

Proposals Invited.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until December 12 for furnishing Eastern Navy Yards with the following electrical material: Schedule 246, electrical wire and supplies; schedule 247, generating sets; schedule 249, zinc anodes. Blank proposals can be obtained at the Navy Pay Office in New York or upon application to the Bureau at Washington.

On December 26 the Bureau will open bids for furnishing Western Navy Yards with the following: Schedule 254, searchlight; schedule 255, motors, zinc plates, etc. Blank proposals can be obtained upon application to the Bureau.

Sealed proposals are being invited until January 5, 1906, for the installation of the electric wiring and conduit systems of two laboratory buildings for the Department of Agriculture. Specifications and detailed information can be obtained upon application to the building committee, Department of Agriculture, Washington, D. C.

ELECTRICAL PATENT RECORD

LETTERS PATENT ISSUED NOV. 21, 1905.

Electric Railways and Appliances.

804,914. Car-Fender. George Allen, Franklin, Pa. Filed July 8, 1905.

805,062. Guard for Third Rails. Augustus A. Hickerson, Reynoldsburg, and William H. Phalor, Sheppard, O. Filed Feb. 6, 1905.

805,096. Trolley-Wheel and Mounting Therefor. Frank N. Russell, Elmira, N. Y., assignor of one-half to Albert D. Lane, Shoshone Agency, Wyo. Filed April 15. 1905.

805,166. Electric Rail. Louis Steinberger, New York City. Filed Jan 3, 1905.

805,225. Electric Trolley-Switch. George H. Negley and Isaac L. Brown, Indianapolis, Ind. Filed Sept. 11, 1903.

805,311. Fender. John L. Matthews, Hydepark, Mass, Filed Aug. 1, 1905.

805,338. Cable-Trolley. John E. Boyle, Scranton, Pa. Filed Nov. 12, 1904.

805,408. Trolley-Wheel. Thomas Broadbent and Israel Hey, Wollaston, Mass. Filed June 17, 1904.

Electric Lights and Appliances.

805,131. Incandescent Electric Lamp. Royal Gerow and George A. Gerow, Northport, Canada. Filed Dec. 31, 1904.

805,248. Electric Lamp. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company. Filed May 8, 1899.

805,282. Incandescent Lamp. Gustavo Germani, Pittsburg, Pa. Filed Oct. 13, 1904.

805,287. Incandescent-Lamp Socket. James J. Hartley, Syracuse, N.Y., assignor to the General Electric Company. Filed May 1, 1903.

805,292. Method of Starting Electric Gas or Vapor Devices. Peter C. Hewitt, New York City, assignor to the Cooper Hewitt Electric Company. Filed Nov. 24, 1903.

805,322. Electric-Arc Lamp. William R. Ridings, Stretford, Eng., assignor to the Westinghouse Electric & Manufacturing Company. Filed March 1, 1904.

805,370. Electric-Light Shade or Hood. Albert S. Marten, East Orange, N. J. Filed March 23, 1904.

Electrical Machinery and Apparatus.

804,849. Electric Switch. Frederick Huffer, New York City. Filed April 9, 1904.

805,092. Electric Transmitter. Jerome Prince, Milford, Mass., assignor of parts to Charles E. Aldrich and John H. Macdonald, Beverly, Mass. Filed Feb. 2, 1905.

805,188. Apparatus for Controlling Electric Motors. Harry E. Day, Brooklyn, N. Y., assignor to Ernest R. Esmond, New York City. Filed May 5, 1899.

805,249. Electric Conductor. Louis E. Underwood, Lynn, Mass., assignor to the General Electric Company. Filed April 1, 1905.

805,263. Time-Limit Device for Controllers. Alexander Churchward, New York City, assignor to the General Electric Company. Filed Oct. 10, 1903.

805,289. Magnetic Separator. Harry E. Heath, Windsor, Conn., assignor to the General Electric Company. Filed Sept. 17, 1903.

805,291. Semaphore-Signal. Reinhold Herman, Crafton, Pa., assignor to the General Electric Company. Filed April 26, 1905.

805,346-415. Alternating-Current Motor System. Albert G. Davis, Schenectady, N. Y., assignor to the General Electric Company. Original application filed April 4, 1898. Divided and last application filed April 9, 1902.

805,416. Electric Motor. Ernest R. Esmond, New York City. Filed Aug. 23, 1901.

Telephones and Telephone Apparatus.

804,848. Telephone Signal System. Amiel R. Hoover, Pleasanthill, Ill., assignor of one-half to C. J. Craigmiles, same place. Filed April 20, 1905.

804,861-862. Multiple Switchboard for Telephone-Exchanges and Telephone Exchange System. Milo G. Kellogg, Chicago, Ill., assignor to the Kellogg Switchboard & Supply Company. Filed Feb. 13, 1893, and Dec. 20, 1894.

804,946. Electric Switch or Disconnecting Device for Telephones. Leonard J. Fletchall, Hatfield, Mo., assignor of one-half to Mark L. Belden, same place. Filed Aug. 11, 1904.

805,126. Multiple-Station Telephone System. Arthur J. Farmer, Detroit, Mich. Filed Dec. 26, 1903.

Miscellaneous.

804,819-820. Signaling System. James E. Allison, St. Louis, Mo., assignor to George M. Seeley, New York City. Filed Aug. 14, 1902, and May 4, 1904.

804,843. Leading-in Conductor for Electric Vapor Apparatus. Peter C. Hewitt, New York City, assignor to the Cooper Hewitt Electric Company, same peace. Filed March 26, 1904.

804,931. Apparatus for Electrolytical Decomposition. Gunnar E. Cassel, Stockholm, Sweden. Filed May 4, 1905.

805,057. Ringing Key. Edward B. Craft, Chicago, Ill., assignor to the Western Electric Company. Filed April 8, 1905.

805,108. Signalling System. Paul Winsor, Weston, Mass. Filed Aug. 11, 1905.

805,167. Insulator-Pin. Louis Steinberger, New York City. Filed Jan. 3, 1905.

805,169. Insulator and Wire-Clamp. John F. Taubold, Scranton, Pa. Filed Feb. 26, 1904.

805,260. Insulating-Bushing. John G. Callan, Lynn, Mass., assignor to the General Electric Company. Filed Aug. 28, 1902.

805,327. Electric Self-Winding Clock. Charles F. A. Sturts, San Francisco, Cal. Filed June 13, 1904.

805,412. System for Wireless Telegraphy. Thomas E. Clark, Detroit, Mich., assignor to the Thomas E. Clark Wireless Telegraph-Telephone Company. Filed Feb. 17, 1902.

THE TELEPHONE WORLD.

Expansion for United States Company.

The directors of the United States Telephone Company held a lengthy meeting in Rochester, N. Y., last Thursday evening. Two points settled at the meeting were expansion of the Stromberg-Carlson plant in Rochester, and the installation of a new plant in St. Louis. President Thomas W. Finucane practically admits that the capacity of the Stromberg-Carlson plant will be doubled, and that the St. Louis plant will be capitalized at $6,000,000.

"The matter of the New York franchise did not come formally before the meeting," said Mr. Finucane, "but was, of course, discussed by the directors. You can say that we have the same kind of a franchise in New York City that the Bell Company has. The Bell has invested $50,000,000 on the strength of its franchise, and if that franchise is no good, then ours is not. Both franchises are similar, and our franchise is just as good as theirs. That's all there is to say on the subject at present. We will wait until the corporation counsel of New York renders his decision before we do anything further."

The stockholders of the Frazeysburg, O., Independent Telephone Company, which was recently incorporated with a capital stock of $10,000, has the following officers: President, Max Frazier; vice-president, Dr. W. S. Drake; secretary and treasurer, S. H. Frazier; general manager, J. B. Rhodes; assistant general manager, Emmett McCann; counsel, Sherman M. Granger. The company has purchased all the property of the Farmers & Merchants' Telephone Company in Muskingum County, including the Frazeysburg exchange and 28 miles of farm lines. A toll line will be built connecting with the lines of the Zanesville Telephone & Telegraph Company and the United States Telephone Company. The system will be improved and an extensive farm line development made.

Application has been made for a charter for the Citizens' Telephone Company of Hartford, Conn. This is an Independent company and will have a capitalization of $1,000,000, with the privilege of increasing this to $10,000,000 as necessary. Mr. D. A. Reynolds, of the State Line Telephone Company of New York City, is one of the leading promoters in the enterprise.

The Wexford County, Mich., Independent Telephone Company has been organized. The company is capitalized at $1,000, and expects to increase the capitalization to $5,000. The officers are: President, G. A. Lake; vice-president, A. B. Southick; secretary, D. L. Rose; treasurer, R. D. Frederick.

Franchises were lately granted by the Doylestown, Pa., town council to the Bell and Keystone State Telephone Companies, who are required to construct an underground system. The companies are enjoined to pay $100 each into the borough treasury for the franchises, the first time any such action has been taken.

The Drain, Ore., Water, Light & Telephone Company has been organized by Ira Wimberry, Benton Mires, W. W. Kent and others.

To Rebuild Four Exchanges.

The Wisconsin Telephone Company has completed plans for the rebuilding of the exchanges at Kaukauna, Appleton, Neenah and Menasha. A new office building will also be erected at Appleton. Two additional copper circuits will be be built from Kaukauna to Appleton, Manitowoc and Green Bay, making six circuits to Appleton and four each to Manitowoc and Green Bay.

Daniel P. Powers, who has been manager in Kaukauna for the company for the past four years, has been promoted to the position of general traffic manager of Wisconsin, with headquarters at Milwaukee. He will be succeeded by F. T. Fallowens, of Winona, Minn.

Telephone Socials in Kansas.

A new social function has been invented by the farmers of Dickinson County, a telephone social. When the telephone owners south of the river wished to build a line to connect with the line north of the river they gave a box social instead of making an assessment. They cleared $40 and built the line. The farmers have more than 1,000 telephones in operation in that county.

The Indian Creek Telephone Company has been organized at Cortland, Neb., by the election of the following officers: H. M. Huestis, president; B. E. Ridgley, secretary; B. B. Jackson, treasurer. The officers also comprise the executive committee, and were authorized to purchase supplies, etc., as soon as possible with a view to putting this line in operation before cold weather sets in.

The Diamond State Telephone Company of Dover, Del., is anticipating a great increase in its business during 1906, and has placed with manufacturers large orders for instruments and material in order to meet the requirements of the development of the telephone service of the Peninsula.

New Milford, Ill., will have a telephone system, a meeting having been held recently at which the officers and directors of the New Milford Telephone Company were chosen and plans made for the construction work. T. W. Evans was elected president.

Recent news from Missouri states that the Spring River Mutual Telephone Company has been granted a franchise to erect a telephone line on the public highway from Carl Junction through Waco to Asbury, and the Lafayette Telephone Company has been granted a 20-year franchise.

The Morris Telephone Company, with its principal office in Roxboro, N. C., was lately formed with $100,000 capital. The incorporators are T. H. Street, R. J. Teague, A. C. Boyles and G. D. Morris.

The exchange building for the Meridian, Miss., Home Telephone Company, is rapidly nearing completion, and will when finished, be one of the finest buildings in that city, as well as the best equipped in the State for telephone service.

Bigelow, Minn., boasts of having a telephone company with four stockholders.

Wisconsin Independents to Hold Convention.

The Independent Telephone Association of Wisconsin will hold its annual convention in Milwaukee, December 20 and 21. The headquarters will be at the Pfister Hotel. The Wisconsin conventions have always been held in February, but the date has been changed to December, as it is considered a more favorable time. An interesting programme has been prepared, and the usual large attendance is expected. Mr. H. C. Winter, Madison, Wis., is the secretary and treasurer.

Telephone Deal Closed.

The Indianapolis telephone deal, by which Toledo, O., and St. Louis, Mo., syndicates have secured a majority of the stock in the new Independent Telephone Company for $70,000, has been closed. C. E. Stinson, formerly manager of the Home plant in Toledo, has taken charge of the Indianapolis property, together with its long distance lines, and he has already reduced the running expenses $20,000 a year.

Temporary certificates have been issued of the underwriting and a voting trust has been established. The trust now controls more than 90 per cent of the stock. New certificates, which will be more negotiable than those now held by the purchasers will be issued in less than a month.

The Fairbury, Neb., Telephone Company is rebuilding its lines. A short time ago the capital stock of the company was increased to provide $15,000, the approximate cost of the projected improvements. The Fairbury company has practically won its fight against the Bell corporation in the town, and will be able with a rebuilt system to make good its pledges to the people and give good service at low rates and keep all the money in its locality.

The Star Independent Telephone Company of Star, Idaho, capitalized at $10,000, has been formed to establish a telephone system in that place, and will also establish long distance connections with Boise, Meridian, Nampa, Caldwell, Pearl, Emmet and Fayette. The incorporators are: H. D. Andrews, J. S. Clark, L. B. Wehr, A. S. Bixby, S. S. Foote and A. W. Hall.

The Independent Telephone Company of Yankton, S. D., has commenced construction work on its extension of the long distance telephone line from Gayville to Sioux City, connecting with the toll lines of the New State Telephone Company, and the Sioux City Telephone Companies.

The Riverton & Delmar Telephone Company has filed articles of incorporation to construct and operate telephone and telegraph lines in Delaware. The capital is $50,000, and the incorporators are mostly of Delmar. Riverton is in Maryland and Delmar is on the Delaware-Maryland State line.

Work is well under way on the new telephone exchange which is being installed in Ensley, Ala.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Abbeville, La.—The town council and water works committee of this city at a recent meeting informally discussed the water plans submitted and the advisability of acquiring an electric lighting plant in connection with the system.

Aberdeen, Miss.—This city is arranging to enlarge the electric light plant. J. M. Acker, mayor.

Bickleton, Wash.—H. T. Latham, of this place, is figuring on the installation of an electric lighting plant here.

Carleton, N. B.—A new electric light station is being talked of for this city, and from it light not only the city streets, but also the west side public buildings, warehouses, etc. The committee, under the chairmanship of Alderman Frink, is securing information as to the cost of a plant, etc., and one also considering an addition to the North End plant.

Castledale, Utah.—J. W. Seeley and C. L. Allen have been granted a franchise to construct and operate an electric light plant here.

Cleveland, O.—Mayor-elect Bernard Miller, of Lakewood, is getting proposed legislation into shape for the city council. A number of improvements are projected for the next year. The first matter to receive the attention of the new administration will be increased electric lighting facilities. An additional 500 hp. dynamo with a new boiler will be installed.

Coalville, Utah.—The city council has approved the plans and specifications for the power house for the electric light plant.

Escondido, Cal.—The city council has received an application from Hugh F. Duff for a franchise to establish an electric light plant and system here. Favorable action was taken and the franchise was ordered drawn and advertised for four consecutive weeks.

Eugene, Ore.—The city council has passed a resolution providing for the issuing of bonds to the amount of $100,000, the proceeds to be used in the construction of an electric municipal lighting plant.

Ft. Worth, Tex.—There is talk of outlining a plan for the betterment of the electric wiring conditions of this city.

Junction City, Ore.—J. N. Fellmer is preparing to erect an electric light plant here.

Lombard, Ill.—The Lombard Utility Company, capitalized at $2,500, will operate an electric light plant. The incorporators are S. J. Lombard, J. W. Burdette and S. W. Norton.

New Orleans, La.—The city council is negotiating for the purchase of the electric lighting plant now owned by a private company.

Potsdam, N. Y.—Justice Henry T. Kellogg, of the Supreme Court, lately rendered a decision restraining this village from building a municipal electric lighting plant, permission not having been obtained from the State Gas Commission, although the resolution to build the plant was adopted by voters nearly three months before the law creating the State Gas Commission went into effect.

Richfield, Utah.—A. J. Poulsen is promoting the organization of a company to install an electric power plant for the purpose of developing electricity for use in the Gold Mountain and Silver Valley districts. Mr. Poulsen plans to erect a plant at a cost of $60,000.

Roseburg, Ore.—The electors of this place have voted in favor of issuing bonds to the amount of $200,000 for the purpose of constructing a municipal electric light and water plant.

Santa Ana, Cal.—The trustees have instructed the city attorney to formulate a resolution calling for an election to vote on the question of issuing bonds for the purpose of constructing a municipal gas and electric lighting plant.

Sioux Falls, S. D.—The proposition to bond this city in the sum of $35,000, to build a municipal electric lighting plant was lately carried.

Steelton, Pa.—The Electric Light Company's plant was lately destroyed by fire. The loss is $60,000 and no insurance.

Tecumseh, Neb.—H. H. Herndon, a promoter from Adams, has been here endeavoring to interest the city council in giving up the electric lighting plant for a company he proposes to organize. For some time the plant has been inadequate, and Mr. Herndon proposes to install a modern plant and run all night.

Williamston, S. C.—The Williamston Cotton Mill of this city will install an electric light plant.

Woodward, Okla.—W. K. Palmer, 718 Dwight Building, Kansas City, Mo., has received the plans and specifications for the new electric lighting plant at this place.

STREET RAILWAYS.

Denver, Col.—A million dollars will be expended by the Denver & Rio Grande Railway Company in installing an electric lighting system for the road.

Duluth, Minn.—A movement is said to be on foot to organize a stock company to build an electric line from West Duluth through New Duluth and Fond du Lac to Carlton and Cloquet.

Freeport, Ill.—There is a strong likelihood that the Freeport & Dixon interurban electric line will be built next season.

Greenville, Pa.—The Shenango Traction Company, which proposes to build a line from New Castle to Meadville via Sharon, Sharpsville and this place, will on December 4 make application for charters for several lines.

Kalamazoo, Mich.—Engineers have completed a survey of a proposed electric line between Elkhart, Ind., and Pavilion, Mich., which if completed, as they say it will be, will make another interurban for this city.

Knoxville, Tenn.—The Knoxville & Maryville Electric Railway Company is the name of a new organization capitalized at $100,000, the purpose of which is to build 16 miles of railway from here to Maryville.

Milwaukee, Wis.—The Milwaukee Electric Railway Company will extend its interurban line from Waterford to Rochester, Burlington and Lake Geneva.

Mobile, Ala.—The Birmingham Railway, Light & Power Company contemplates, it is said, the construction of a trolley line over the proposed Red Mountain Road in the event of its being built by the city and the county.

Ossining, N. Y.—A trolley line is to be built in Westchester County, to extend from here to the new Croton Dam, thence to Croton-on-Hudson, Oscawana Crugers, Montrose and Verplanck's Point.

Rutland, Vt.—The Vermont Internal Improvement Company has been organized here with a paid-up capital of $100,000. Its business will be the buying, selling and leasing of electric railways in Vermont, with a charter granted in 1902, which is practically unlimited as to scope, and permits the increase of capital into the millions if necessary. The officers are: President, G. Tracy Rogers; vice-president, Leo H. Wise, of New York City; secretary and treasurer, Charles H. West, of this city.

Selinsgrove, Pa.—The borough council at a special meeting granted a right-of-way for an electric trolley line through the main streets of this place.

Skowhegan, Me.—There is talk of a third rail electric line from this town to Farmington, to run through the villages of Norridgewock, Mercer and others.

Springfield, Ill.—The Secretary of State has incorporated the Joliet & Southern Traction Company, which intends to build a road from Joliet through the counties of Will, Grundy and Livingston to Dwight.

Sturgeon Bay, Wis.—An electric line from this city to many of the towns of the North is likely to become a reality.

Union City, Mich.—It is reported that another electric line is to go through this city.

Waynetown, Ind.—The right-of-way is being secured near this town for the new traction line. Eli Baker and Ed. Reynolds are interviewing the farmers in regard to the matter.

POWER PLANTS.

Anderson, S. C.—Joseph E. Sirrine, of Greenville, has prepared plans for the electric power plant which is to be constructed at Hatton Shoals on the Tugalo River, to develop 5,000 hp. for the Hatton Shoals Company, of which R. B. Ligon, of this city, is president.

Georgetown, Col.—The Waldorf Mining & Milling Company plans extensive improvements. The purchasing of the Dryden mill site recently has brought to light the fact that the company proposes installing a complete electric power plant.

Knoxville, Tenn.—The Oliver-Stewart Company of this city has been incorporated with a capital stock of $25,000, by W. J. Oliver, of this city; A. B. Stewart, of Columbia, S. C., and George F. Parkes, of Nashville. Its purpose is to construct a power plant on the Tennessee River 30 miles from Chattanooga.

Lineville, Ala.—Messrs. Henderson, Lewis Brothers & Co., of this city, will build a cotton mill and develop a water power, to which will be connected an electric plant for transmitting the power to the proposed cotton mill and to other industries.

San Jose, Cal.—C. W. Fancher, Thomas Harris and T. B. Gambel, of this city, will erect a power plant at Yerington, Nev.

BIDS WANTED.

Freeport, Ill.—The city council will receive bids for electrically lighting this city for a term of five years.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 17⅜@17¾c.; Lake 17½@17¾c.; casting, 17@17½c.

Reports of an increase in capital of the Westinghouse Company are denied in Pittsburg.

The advance in copper metal to the highest price in five years is causing heavy purchases in the stocks of producing mines.

Control of the United Railways Company of San Francisco has passed from Brown Bros. & Co. to Ladenburg, Thalmann & Co. and associates.

There is a report that the earnings of the National Carbon Company for the present year will approach something like 8 or 10 per cent. on the common stock.

General Electric rights are being dealt in on the curb in New York. The rights are worth about $10 per share at current price of General Electric stock.

Application has been made to the New York Stock Exchange to list $4,000,000 Keystone Telephone Company of Philadelphia first mortgage 5 per cent. bonds of 1935.

Philadelphia Rapid Transit October earnings were very large, the gross showing a gain of $94,000 over the same month last year. This is an average increase of over $3,000 per day. and is the largest increase of any month this year.

Henry L. Doherty has been elected a director of the New York & Queens Electric Light & Power Company. He is connected with many lighting companies, and has been general manager of the American Light & Traction Company properties.

The time for deposit of stock of the San Francisco Gas & Electric Company and the California Gas & Electric Corporation, which are to be merged into the Pacific Gas & Electric Company, with the Union Trust Company of San Francisco, has been extended to December 1.

The Commercial National Bank of Albany, N. Y., up to the close of business Saturday, had received on deposit 94 per cent. of the capital stock of the United Traction Company, and it is expected that the entire issue will come in under the offer of purchase at $150 a share made by the Delaware & Hudson Company's interests.

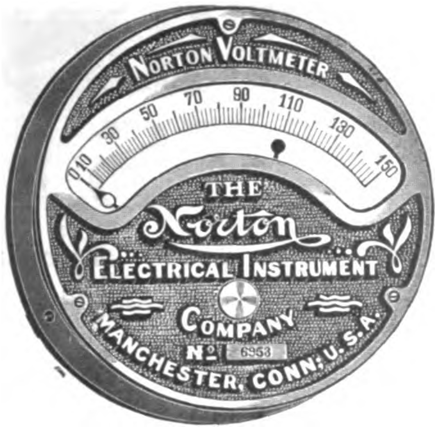
The new stock of the Philadelphia Electric Company of America will make about 448,646 shares, par $10, or $4,486,465 outstanding. The company is paying 7 per cent. dividends and earned last year 10 per cent., or about $450,000 on the capital stock then issued. Allowing for the 35-cent dividend in January, the rights at the market price of 11⅜ figure a value of about $12.50 on 100 shares.

A rumor is current that a suit of some kind is threatened against the Metropolitan Street Railway and the Metropolitan Securities Companies of New York. Its character has not been revealed, but there are hints that if another assessment is called on the Metropolitan Securities Company payment of it will be enjoined. Local interests in the properties say they know nothing whatever about the matter.

The Helena (Mont.) Light & Railway Company, which took over the entire electric lighting, street railway and gas service of Helena, reports that the common and preferred stock now issued amounts to $935,000. The present issue of securities provides funds for acquiring the properties and more than $160,000 for improvements and additions. For ten months of 1905 the net earnings were $66,081, nearly $14,000 more than the annual fixed charges.

ELECTRICAL STOCK QUOTATIONS.

Name.	Closing price Nov. 27
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	212¼
Manhattan Elevated Railway	163½
Metropolitan Street Railway	120⅝
Metropolitan Securities	72⅜
Ninth Avenue	197
Third Avenue	122
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	88½
Brooklyn City Railway	239
New Orleans Railway	38
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	81⅜
Philadelphia Traction	100¼
Union Traction	62½
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	13
do. do. do. pref	57
West End Street, com	98
do. do. do pref	113½
Chicago.	
City Railway	192
North Chicago	83
Union Traction, com	11
do. do. pref.	40
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	20⅛
do. pref.	68
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	15½
do. do. pref.	21
Westinghouse, com	175
do. pref.	190
General Electric	188
Boston.	
Edison Electric Illuminating	245
General Electric	188
Westinghouse Electric & Mfg., com	85½
do. do. do. pref.	100
Chicago.	
Chicago Edison	161
National Carbon, com	62½
do. do. pref.	116
Philadelphia.	
Electric Company of America	11½
Electric Storage Battery, com	81
do. do. do. pref.	81
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	136⅜
Western Telephone Company	13¼
New England Telephone Company	184½
New York.	
American Telegraph & Cable Company	93
Commercial Cable Company	210¼
Mexican Telephone Company	1
New York & New Jersey Telephone Company	179½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92⅜
Chicago Telephone Company	138
MISCELLANEOUS STOCKS.	
Chicago Subway	49½
Otis Elevator Company	68
Standard Underground Cable	..
Twin City Rapid Transit	115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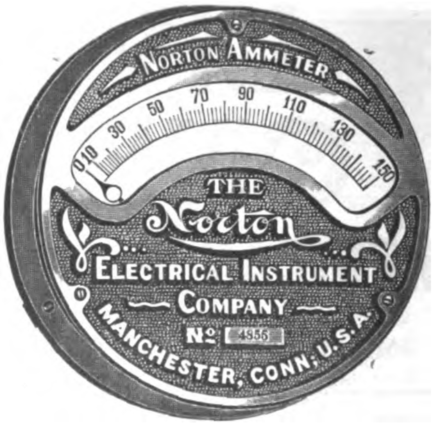
THE Norton ELECTRICAL INSTRUMENT COMPANY
Nº 6953
MANCHESTER, CONN. U.S.A.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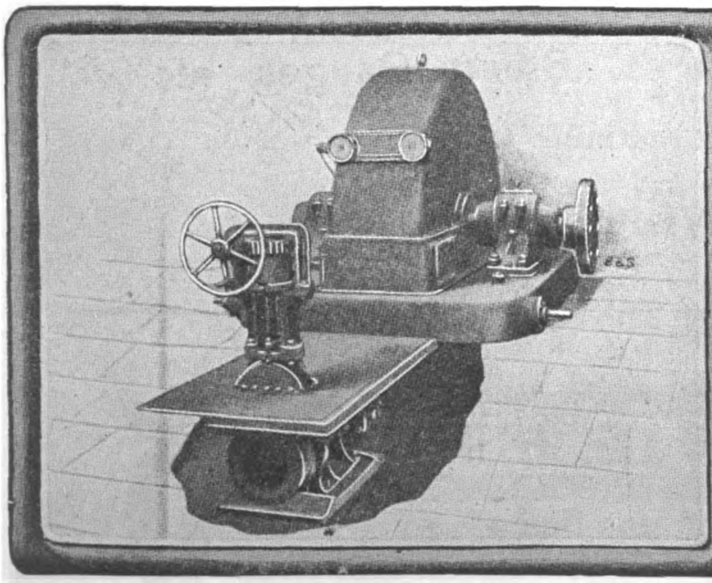

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EDITORIAL NOTES.

Electric Typesetting. Though not widely discussed the electric typesetting machine is already an actuality. Its position in the field for which it is intended is being more assured every day. By this is meant that the idea of typesetting by electricity, though not entirely novel, at least represents the tendency noticeable in a great variety of directions to apply electricity to all forms of arduous labor wherever possible. The graphotype, as it is called, is an electric typesetting machine, in the sense that instead of the lead being melted by gas flame it is liquefied by passing through a metal tube heated by electricity. The matrix by which the letter is formed is made by electricity, and finally, the entire movement of the working parts is caused by the use of electric power. The suggestion implied by the use of electricity for typesetting is not to be disregarded, whether the graphotype does or does not find its place in the composing room. The history of invention clearly shows that the inventions that survive the test of time are valuable only in the respect, to use a simile, of making two blades of grass grow where only one grew before. They survive if they are able to give more in either quality or quantity of output than have been formerly obtained. The introduction of the typesetter, or typemaker and typesetter, meant the establishment of daily newspapers on an entirely new basis. It not only facilitated composition in a typographical sense, but was the positive means of developing the great newspapers. The electric typesetter thus has its work cut out for it. If time and expense are saved by its use radical changes will soon be noted in the composing rooms of the leading papers and magazines.

A Remarkable Electric Locomotive. Now that electricity is accepted on all sides as the power destined to transform our railroads, as it has our local city car lines, into a new system of propulsion, the fact that a new and most remarkable electric locomotive has been tried and tested adds to the general interest prevailing in regard to the nature of this invention. Though using the word invention in a popular sense, the better title to apply would be that of system in this instance. The idea crystallized in this case is best understood as a chain of transformations, consisting of and beginning with, first, the development of mechanical energy from the explosion of gasoline in a specially constructed engine; second, the development of electrical energy by means of a generator driven by the said gasoline engine; third, the storage of the electrical energy in batteries where it is always ready for use; fourth, the utilization of the electrical energy stored in the batteries by motors which drive the locomotive containing the apparatus. In other words, the remarkable feature of this locomotive is discovered in its method of generating power and its manner of utilizing it. The engineering world is fully agreed on this point—that the control of the movement of a vehicle by electricity is unsurpassed by any other imaginable method. They, as a whole, have fully realized the necessity for greater progress than hitherto obtained in the art of railroading. It became almost a tradition among them that the limits of steam propulsion on land have been closely approximated, and that it would mean a totally new scheme of operations that would invite better speeds and a higher economy in developing the higher phases of railroading.

To get better speeds and a higher economy is therefore the keynote to the situation. This, in addition to a less complicated form of control, seems to illustrate the features embodied in all attempts to raise the standards of traction, either as they exist in short stretches of suburban track or over the long reaches of transcontinental lines. The invention and system therefore of the new electric locomotive embodying some of these possibilities demands our attention.

It is the work of Lars Nelsen, and makes a speed of 50 miles an hour. The general superintendent of the Baltimore and Ohio Railroad and the superintendent of motive power of the Pennsylvania Railroad were among the specialists taking a ride in this substitute for the familiar form of steam locomotive. It is intended to replace the locomotive proper on all branches and spur lines, and judging from the results of a highly satisfactory test, attended by experts other than the railroad officials, this intention may be soon rapidly carried out in general practice. The apparatus employed was an 80 hp. gasoline engine driving a 50 kilowatt generator. The electricity was fed into a storage battery consisting of 103 cells, and used as required in driving the entire equipment. It is thus seen to be really a complete electrical generating and storage battery plant, whose energy is ultimately consumed, subject to the motorman's control, as in the case of any other electric car. But a locomotive must necessarily possess sufficient grip on the rails to move whatever is attached to it without stoppage. In this respect the sheer weight of the steam locomotive is a distinct advantage, but it is not a disadvantage in the case of this unique combination of parts described, for the reason that this is readily compensated for by the use of more, or at least larger, gasoline tanks. It is thus seen to be a case in which the possibility of the tractive effort, if reduced by the generating and storage battery equipment, may be adequately made up by the carriage of more liquid fuel. Pound for pound, gasoline gives out many times the available energy of coal, particularly as coal is now burnt under the boiler for steam making. The standards of economy are therefore bound to be exceeded, in spite of the fact that the energy obtained from the gasoline is passed through the engine, the generator, the storage batteries and then the driving motors. It is not at all difficult by the use of electricity to completely shatter the standards of steam engineering and establish higher ones. For this reason a gasoline electric locomotive is on its face a distinct step forward. It means a *coup de grace* in hastening the already heralded demise of steam traction.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

The annual meeting of the Underwriters' National Electrical Association will be held in the rooms of the New York Board of Fire Underwriters, 32 Nassau street, to-day (December 6) at 10 A.M.

◆

Telephones connected with a transmitter on the pulpit were placed in the Munn Avenue Presbyterian Church, at East Orange, N. J., on Sunday last, to enable persons in the rear of the edifice to hear distinctly.

◆

The Bureau of Steam Engineering of the Navy Department will soon conduct an official efficiency and steam economy test of a 1,200 hp. Curtis turbine erected for demonstration purposes at the works of the Bliss Company in Brooklyn, N. Y.

◆

The American Society of Mechanical Engineers is now holding its 52d meeting in New York City. The Edison auditorium of the New York Edison Company will be the center for some of the sessions. The convention will conclude its labors on Friday.

◆

It is learned that already nearly sufficient proxies have been received by the General Electric management to carry the recommendation of the board of directors in regard to the new stock issue. It is probable that December 16 will also be fixed for closing the books for the subscription privileges to the new stock.

◆

The New York State Association of Electrical Contractors will convene in Buffalo on January 16.

◆

Lee W. De Forest, inventor of the De Forest wireless telegraph system, says the "wireless transmission of power" is not a wild dream, but a scientific possibility. "The history of wireless electricity is but a repetition of the wire system," says De Forest. "First crude signals, then intelligence conveyed over the wires, next speech and lastly power. Years ago when the first crude signals were sent over the wires it was thought that a separate wire would be needed for every character of the alphabet. I am now experimenting in my laboratory at Jersey City with wireless telephony. My work is already attaining some form. As soon as the wireless telegraphy is a little more improved I expect to bring out a system of telephoning without wires which will come into general use. After that the transmission of power through the air without wires will come. It will follow just as surely as it did in wire electricity. I am working in that general direction now. I can in a sort of way see the end of the development."

◆

At a recent mass meeting of civil, electrical, mechanical, mining, military and naval engineers in Washington, D. C., an organization was formed to be known as the Washington Society of Engineers.

◆

The Elkins-Widener Syndicate of Philadelphia, which has been negotiating for the street railways of Cleveland, O., dropped the matter on Saturday. Mayor Johnson insisted that a three-cent fare be maintained, and the syndicate decided not to buy.

◆

Lieutenant Commander S. S. Robinson, of the Bureau of Equipment of the United States Navy, with the mayors of Wilkes-Barre and Scranton, Pa., and other guests witnessed the first public test of the Murgas system of wireless telegraphy. The test was conducted between experimental stations 22 miles apart, between Wilkes-Barre and Scranton, and was successful. Every message was accurately recorded. The messages were sent by the Morse code, 45 words a minute.

◆

The 200th anniversary of the birth of Benjamin Franklin, philosopher, scientist and statesman, will be observed in Chicago, Wednesday, January 17, in connection with the electrical show. It will be known as "Ben Franklin Day" and the features will be such that will demonstrate the marvelous development in electricity, the science in which Franklin's experiments and discoveries formed a foundation for the wonders of to-day.

◆

A lecture on "Electric Heating" will be given by Mr. W. S. Hadaway, Jr., before the Electrical Engineering Society of Columbia University, New York City, in room 301, Engineering Building, this (Wednesday) evening at 8:15 o'clock.

◆

The wireless telegraph station at Manhattan Beach, N. Y., was lately in communication with the stations in both Galveston, Tex., and New Orleans, La., there being a distance of more than 1,200 miles between the stations.

ELECTRICITY IN SERVICE ON BRITISH BATTLESHIPS.

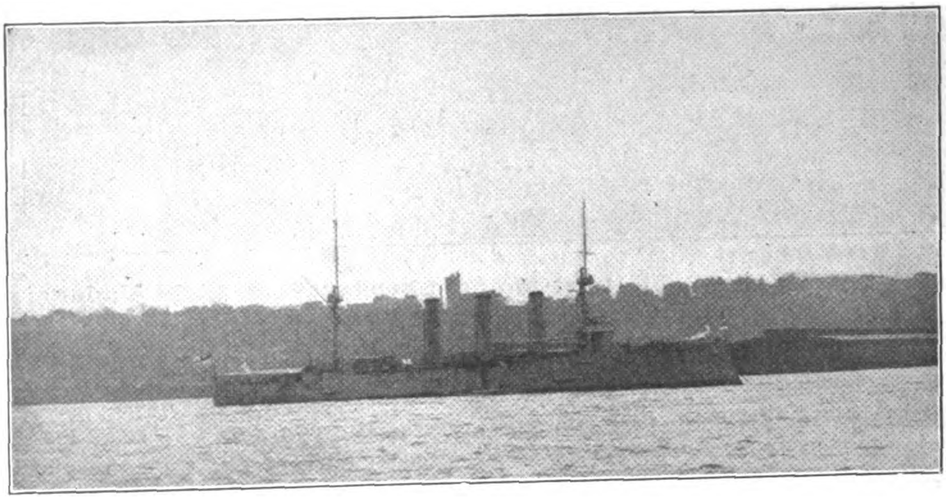
BY EDWARD NELSON.

Modern naval warfare represents the highest and best applications of electrical and mechanical devices. In many instances the apparatus does not differ in any particular detail from the same type and class used for civil purposes. But the extraordinary requirements of warfare have made it necessary to strengthen and embellish the apparatus to meet the rude shock of actual service. The modern battleship is theoretically and practically a vast fighting machine in which two forms of energy are extensively employed. The ship is propelled by steam power, but electricity is the reigning influence with regard to the lighting, the ventilating, the signaling, the adjustment of huge mechanisms, such as 13-inch guns, and the actual communication established between battleship and battleship.

The following description of the electrical apparatus found on one of the British cruisers, which recently visited New York, will cover the principal features of the mechanism employed. These cruisers represent the most modern ideas in the field of naval engineering. H. M. S. "Cornwall," from which the accompanying illustrations were obtained, was placed in commission a year ago, when war seemed imminent over the North Sea fishing tragedy.

With regard to her lighting, it may be stated that the generators employed consist of four direct-connected compound wound dynamos of 50 kilowatts apiece. The pressure they generate is carefully kept at 100 volts for reasons which relate to the naval signaling scheme. But the generators with 500 amperes capacity apiece otherwise supply their power for consumption in the lighting system, and the motor system above and below deck, and in the ventilating system.

The generators feed into a common switchboard and are attached to a pair of bus bars and an equalizing bar to absolutely preserve uniform potential under all conditions of load. Great stress is laid upon the preservation of the pressure, in fact speed indicators are attached to the dynamos whose dials are so subdivided that a difference in the revolutions per minute between one machine and another is immediately detected and remedied. The engines driving the dynamos are of the regular high speed condensing marine type, running at an average speed of 570 revolutions per minute. The main switchboard consists of a glass inclosed cabinet, the doors of which open outward. This switchboard is made of slate and has mounted upon it, measuring, protective and controlling apparatus as follows: Each generator has a main switch, a circuit breaker, ammeter, voltmeter, ground detector and lightning arrester. The rheostat controlling the shunt fields is likewise mounted conveniently at hand. A polarity indicator is employed in addition to the other apparatus, to prevent a reversal of current in any of the circuits.



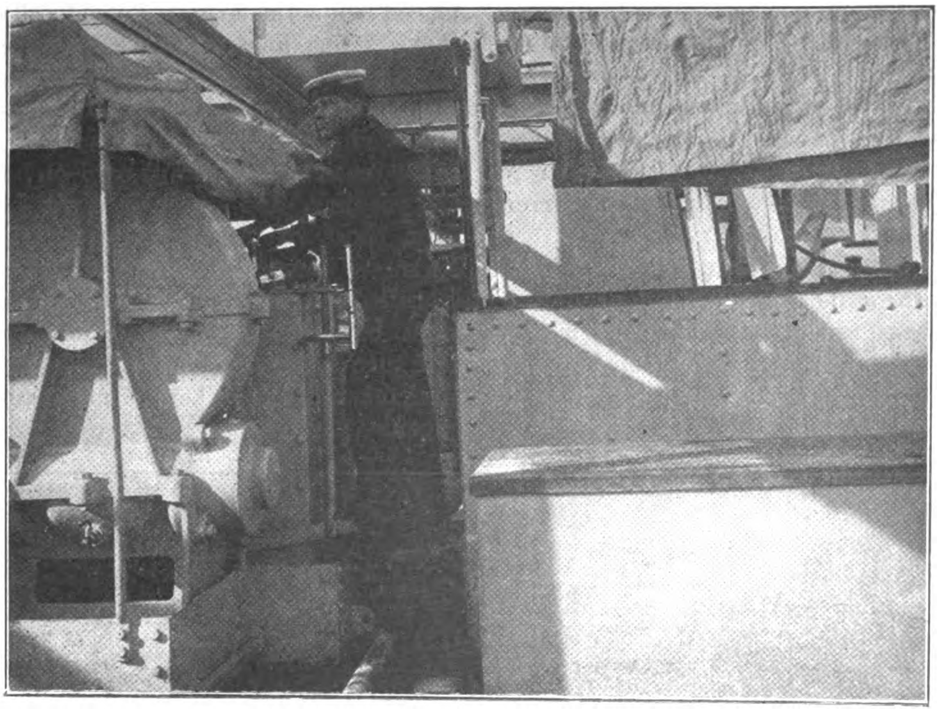
H. M. S. "Cornwall."

The generating plant is so designed that each unit can be run independent of the others, or the entire number may be thrown in multiple. Provision has been made in mounting the generators to avoid the disturbing effects of gyroscopic action. In war vessels particularly, the swift movement of the vessel is one of the purposes of its design, and it is evident that any heavy, rapidly rotating mass would tend to swivel around during such operations. In this respect both ocean liners and battleships have taken the precaution to mount all armatures parallel to the keel, thus reducing the wear on bearings, and the strain spoken of on the moving parts. The position of the dynamos is toward the middle of the vessel and mounted on a substantial bed plate, strong, though not necessarily heavy, to avoid the pitching and rolling due to the immense weight of the superstructure. In addition it may be stated, that the shock due to the impact of heavy projectiles, calls for a design and construction which will permit of operation under all conditions. It is vital in naval warfare that the lighting and signaling be carried on if an engagement occurs at night. The importance of this is accentuated by the fact that not only must there be light on board during an attack, but the movement of the heavy guns themselves is controlled by motors receiving power from this source. The position of the plant like that of the boilers is such that it it almost impossible for a shell to reach it. In fact, to gain more protection in this respect, two of the generators are placed below the armored deck, and two above, which, however, are well protected against shot and shell by steel bulkheads, and several compartments with walls of hardened steel.

The incandescent lamps used on board are peculiar, and differ in their bases from those of American manufacture. No screw bases are employed, but what is called the bayonet catch; the lamp must be pressed forward and given a half turn to engage with the detaining mechanism in the socket. During an engagement in that part of the ship subjected to the greatest vibration, the lamps are readily shattered. The powder and ammunition handling rooms and magazines, as well as other parts of the interior of the vessel during the day as well as night, are dependent upon the dynamos for their illumination. The incandescent lamp is the only solution of the lighting problem in chambers containing high explosives. A lamp must instantly give light when applied to the socket in these warships, as time is an element of the greatest importance during certain moments of action. The lamps are protected by an outer globe so that the fracture of the lamp itself invites no risk of explosion.

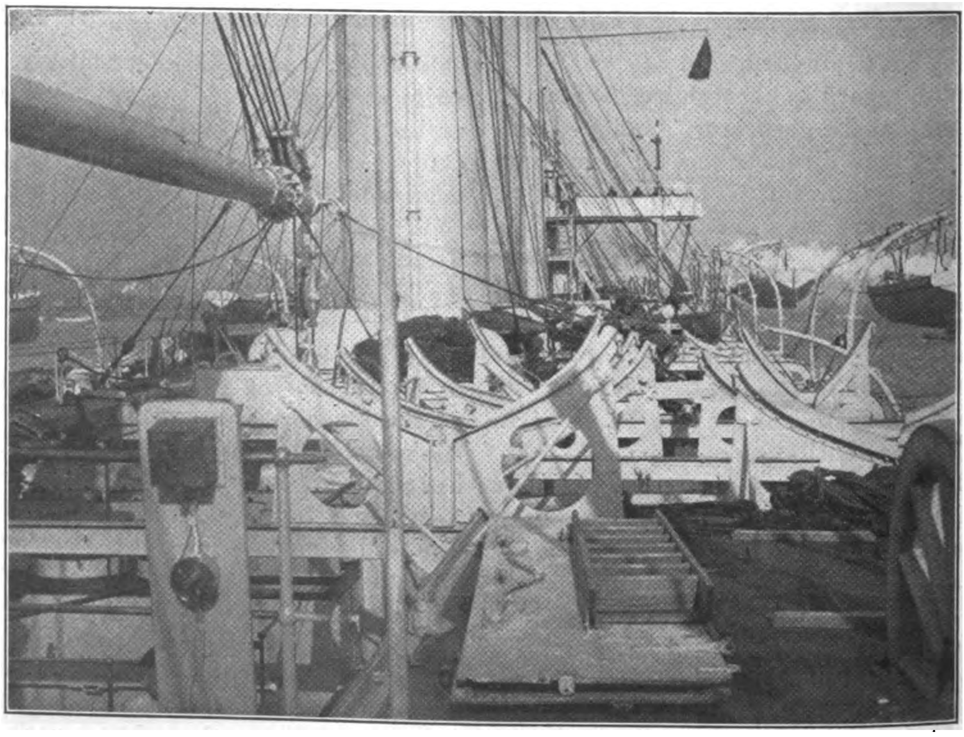
In all there are 900 incandescent lamps in use, ranging in candle power from 1 to 50, including candle powers of 5, 8, 16 and 32. The 1 cp. lamps are employed at night to illuminate the sights of the quick firing guns. In addition to the incandescents two powerful searchlights of about 100,000 cp. are used for signaling purposes and smaller searchlights for general use. The illumination of the coal bunkers during the act of coaling is accomplished by four arc lights.

To light the decks half shaded police lamps are employed, which turn the light entirely inward. The control of this system of lighting is obtained by means of waterproof switches inclosed in iron boxes. When additional illumination is necessary portable clusters are employed.



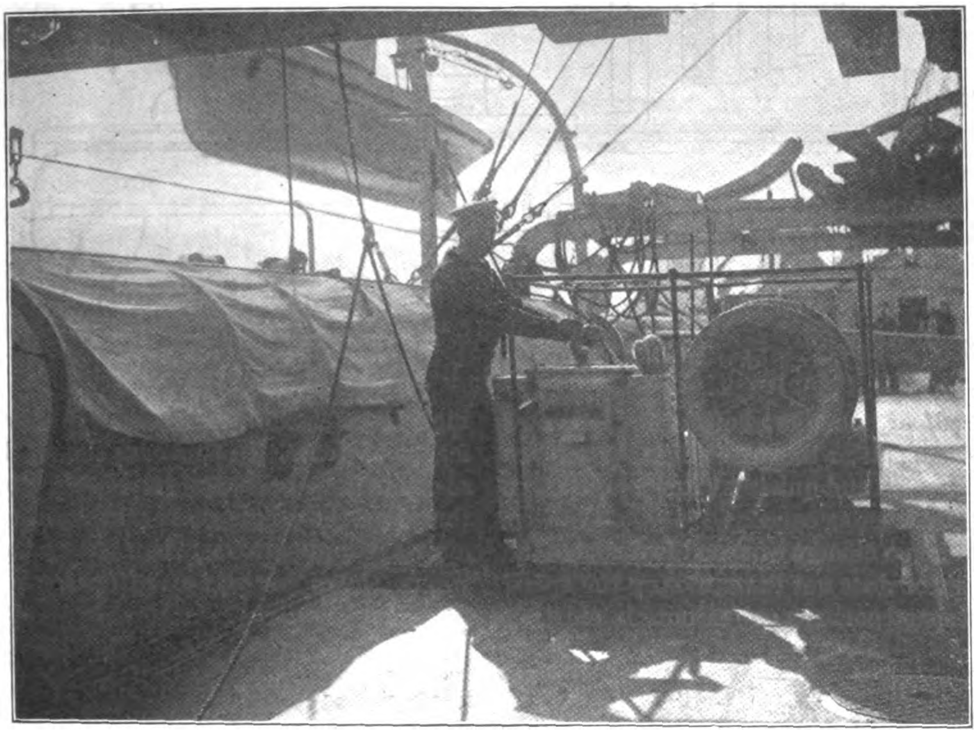
Controller for Boat Hoist Motor, Showing Pilot Light Under Right Arm of Operator.

Scattered about the deck and superstructure are a series of iron incased terminal boxes to which these portable lamps can be attached; in all there are eight, providing means for rapid temporary illumination; each box has two connecting sockets. One of the sockets is supplied with a resistance in series for the ready connection of an arc lamp. This resistance is cut out when a regular cluster light is used instead. These lights are provided with highly polished brass reflectors and the connecting wires consist of a heavily armored, flexible, waterproof, insulated cord. For night signaling a masthead flashing system is employed, which is controlled by a heavy pattern telegraph key. The lamps employed for this purpose are of 6 cp. arranged in a bank of 16.



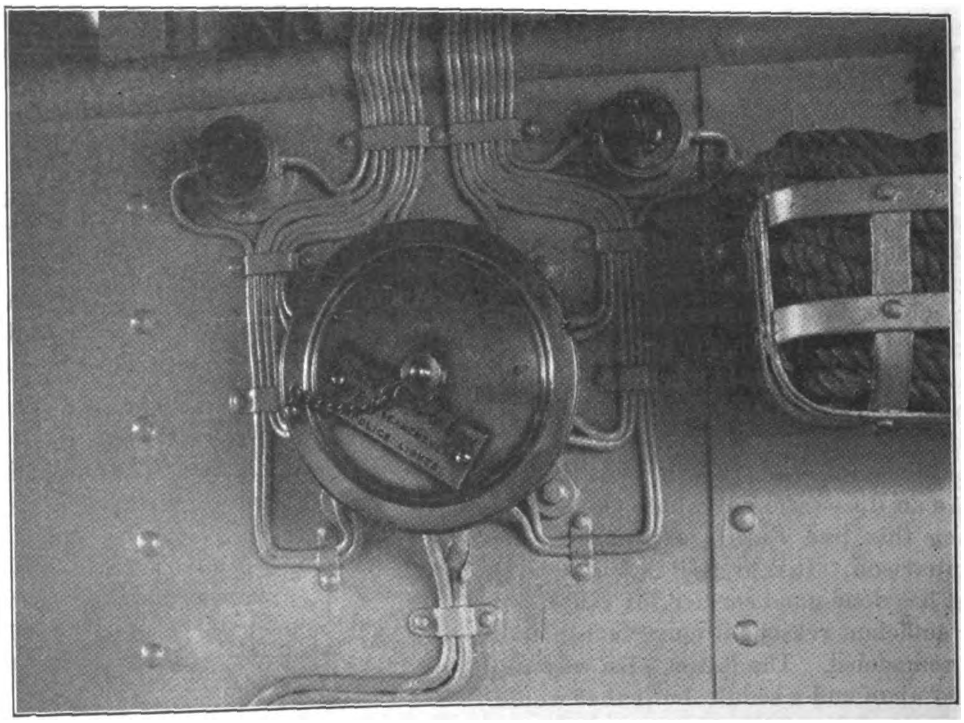
View Overlooking the Superstructure, Showing Searchlight and Semaphore on Signal Bridge.

The power equipment relates largely to the ventilation of the lower decks, control of the heavy guns in the barbettes, the handling and hoisting of ammunition, weighing the anchors, and for general hoisting purposes, including coaling. Unfortunately, owing to naval regulations, it was impossible to secure photographs of the interior of the barbettes or conning tower. But it may be stated that the guns are mounted in pairs in the barbettes on the fore and half shelter decks. The gunners have at their finger tips a pistol grip apiece. The function of this is to train the guns and at the critical moment a trigger is pulled, which acts as a circuit-closing device, ignites the powder and fires the shell. The breech of the gun contains a fuse which is ignited by current controlled by the gunner. The smaller guns are trained by hand, but fired electrically. To prevent premature ignition in the breeches of the guns safety attachments are provided, which make the firing mechanism inoperative until the breech blocks are properly closed. The ammunition supply is obtained in three different ways of an electrical character; the first is an endless chain conveyer operated electrically for the largest guns; second, an endless rope hoist for guns of less calibre, and third a a whip hoist for the quick-firing ordinance. The batteries used for ignition of the guns are contained in waterproof metal cases. The conductors leading from them are heavily insulated and protected by a braided metal armor covering of about half an inch diameter. The motors for training the guns in the barbettes are series wound, because the load they bear is constant. The extremely delicate balance of the guns makes it unnecessary to use very much power because in spite of their immense weight they can be moved by a touch of the hand. On the wall of the barbette is a switch which controls the fire of the gun. This switch is of such a character that it enables the guns to be fired either separately or simultaneously. In other words, the switch sends the current into both guns in multiple if necessary. But the overheating of a gun would mean its temporary isolation from the firing circuit and in consequence a switch which would enable it to be cut out as described. The use of electricity is shown to be the main influence in the lighting of the ship, in signaling by means of searchlights, and the handling of the ammunition, and in the movement and firing of all guns on board. The current is used for other purposes, such as the hoisting of the heavy boats, some of which weigh as much as 18 tons. This hoisting machinery consists of iron-clad fully incased waterproof multipolar motors. They are geared to winding drums, and governed by controllers which permit of six different speeds in either direction. Each motor is provided with a pilot light inclosed in a composite, heavy glass and metal hood, which indicates the condition of the circuit at that point. There are two hoists used for coaling purposes similar in design. They are of approximately 30 hp. apiece, and are capable of adjustment by the removal of hand plates held in position by screws and wedges. Steering is accomplished by means of a combined electric and compressed air equipment called a telemotor. This device is so constructed that the steering wheel must be firmly held at all times, otherwise the rudder will swing to its normal position, due to the swing of the handle. In other words, the rudder remains in a normal position when the wheel is controlled by the helmsman. The helm indicators show the angular position of the rudder, and are provided with electric lights for night work. The scale is divided in the center, and one-half is provided with a green glass dial and the other half is red. The circuits are so arranged that when the rudder is turned to port, that half of the indicating scale is illuminated; and when to starboard the corresponding half is brightly lit. There are four steering wheels occupying the following positions: The first is on the signal bridge, which is the normal position of the navigating officer. In case of an engagement, this position would be vacated and the control of the ship directed from the conning tower, the second position. The two other positions are below the armored deck, a location comparatively safe under all conditions. The log in the fore chart house is read by means of an electric indicator which connects with the regular registering device at the stern.



Electric Motor Coal Hoist.

The telephone is used extensively throughout the vessel, in fact to such a degree that a central station is necessary to facilitate the transmission of messages. This station is situated in the conning tower, and communication is readily established between it and and all the heavy gun positions, the signal bridge and engine room.



Watertight Distributing Box and Switches, Showing Method of Wiring.

One important electrical equipment, in addition to the telephone system, is the wireless telegraph apparatus in use. This is located on the after bridge, but is in direct communication with the fore bridge by means of a telephone circuit.

Examination of the data presented will readily show that the control of the vessel for navigating and naval purposes is centered near the bridge, from which orders can be given by the commanding officer and readily transmitted. The general conditions prevailing at sea are such that the fewer wires employed the better the service obtained. In many parts of steel vessels a single wire is run, the hull providing a return. All conductors exposed to the salt air are heavily protected and armored. In spite of this precaution many faults develop in the course of a trip. To obviate this difficulty a very complete testing system is employed, represented by a corps of able electricians. Their duties consist of a series of daily tests of every line and circuit on the ship, whether relating to light and power or signaling. The testing equipments consist of high grade galvanometers, bridges, milliameters and millivoltmeters. The ammeters and voltmeters on the switchboard are of the Weston type, American manufacture, but the majority of the other apparatus for measuring or testing is typically English in construction.

◆

Lake Titicaca, the highest navigable lake in the world, is to be tapped for electric power to run the Peruvian railroads and to supply a surplus sufficient, it is believed, to enable Peru to take a promnent place among the manufacturing countries.

ELECTRIC MOTORS IN THE MACHINE SHOP.

BY W. H. WAKEMAN.

ARTICLE I.

While there are many places in which electric motors are the favorite means for transmitting power, they give special satisfaction in machine shops, or where machine tools are built, requiring the use of lathes, planers, drill presses, etc.

The material used in these shops is not only heavy but bulky also, requiring much space for the operation of working it into the finished product; therefore where power is transmitted by belts the friction load is frequently from 50 to 60 per cent. of the average load, and in one case in which the writer made a careful test it exceeded the latter figures by about 5 per cent.

This unprofitable condition of affairs was due to the fact that when a lathe or a planer was wanted it was set up there without regard to the difficulty of transmitting power to it. A line of shafting with brood pulleys of small diameter was run to some point near the above-mentioned machine, a countershaft was put up over it, belts were laced and work soon commenced.

This shop has a wide reputation among users of machine tools and has enabled those interested to make money in the past, but times have changed and every effort must be made to reduce cost of production and turn out better work now.

Here is one case where the electric motor is superior to other means of driving a machine, as it requires no line or countershafting. The next problem to be solved in such a case is whether to equip the old machine with motors, or sell them and buy new ones with motors already mounted on them.

As an illustration of what can be done along this line Fig. 1 is presented for comparison. It represents a belted lathe that has done good service for years, but for sufficient reasons it must be replaced or remodeled. The latter plan was decided upon and a saddle built that would rest upon two spindle bearings, and thus support a motor for driving it.

Fig. 2 is the same machine with a motor in place ready for work. The difference in power required to run this lathe would not warrant the change, but when we know that now there are ten times as many speeds available as formerly, it becomes plain that a greater variety of work can be done and much more produced per hour than before, for it is now an easy matter to run at high speeds for light work and quickly change to slower speeds when necessary.

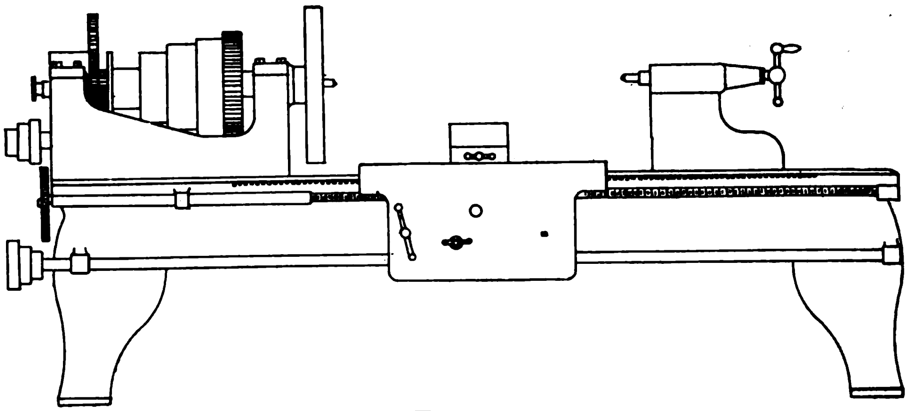


FIG. 1.

When a change of speed is desired the operator does not have to stop the speed and spend perhaps one minute in shifting the belt, as he controls the speed by a suitable device located in the apron of the lathe.

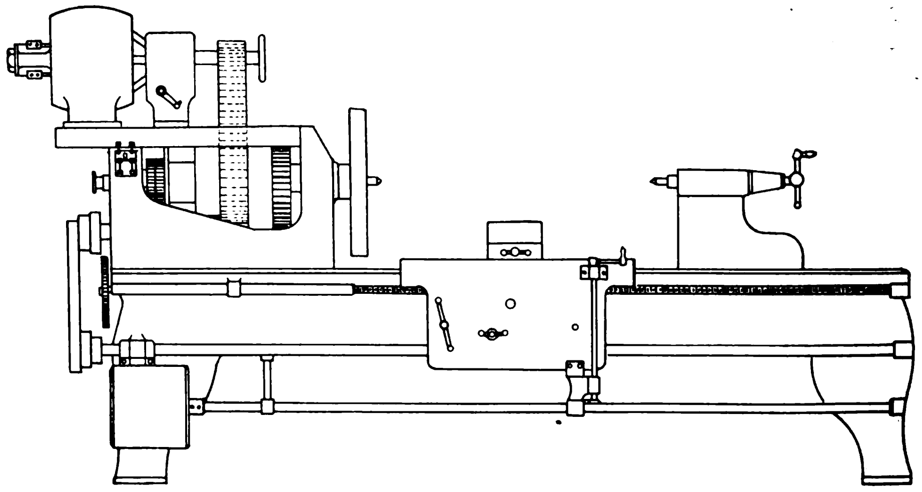


FIG. 2.

A split gear was clamped on the second step of the cone pulley and driven by a silent flat chain, making a positive drive at all times. This is much superior to a belt, which would surely be troublesome on account of the short distance between driving centers.

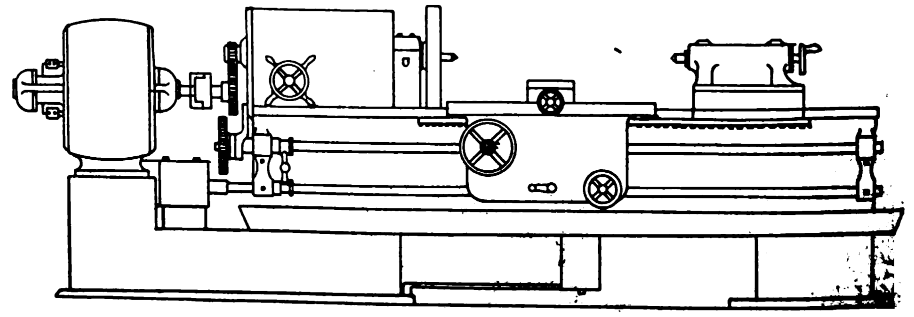


FIG. 3.

There are other tools to which motors may be applied with profit, and this illustration is given to demonstrate the possibilities along this line.

Fig. 3 illustrates a Lodge & Shipley high speed lathe driven by a motor by means of gears. In this case the machine seems to have been designed for a motor, therefore the whole presents a more symmetrical appearance than is possible where the motor was an after consideration.

In order to take advantage of the highest speed possible on light work it is necessary for a motor to be designed for great and sudden changes in speed. It is generally understood that the speed of motors is frequently changed by providing a rheostat that presents great resistance to the flow of current when only a small amount is wanted to drive a machine slowly, thus wasting energy, but this defect is much modified in the latest improved motors for the service above described.

Fig. 4 illustrates an inclosed motor driving a pair of shears for quickly cutting off iron bars to any required length in places where they are used in large quantities. The shaft to which the motor is directly connected also carries a heavy balance wheel that assists greatly in maintaining a uniform speed under great and sudden changes in load. When a bar of iron is to be cut off the shears must do their work by a sudden short movement of the cutting edges, which would quickly check the speed were it not for the balance wheel, but before its momentum is absorbed by the resistance offered the bar is cut off and the machine is running light again.

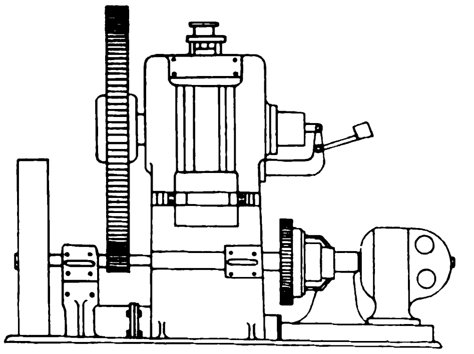


Fig. 4.

Fig. 5 represents one of the neatest applications of a motor that I have ever seen. It represents a grinder with an emery wheel on each end and an inclosed motor in the middle. As it is wired from under the floor there is nothing to indicate that it is anything but a self-propelled machine, so neat and clean is its appearance.

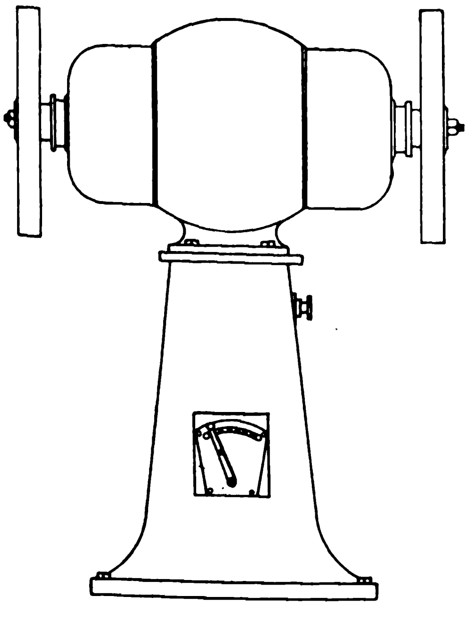


Fig. 5.

If an ordinary grinder was driven from a countershaft in the room below, and the belt came up through the hollow base where it could not be seen in the machine room, it would compare favorably with this type, but I have never seen one fitted up in this way. If it should be attempted it would be difficult to arrange a belt shipper that could be worked quickly and easily. It is generally driven from overhead, bringing the belt very much in the way when certain kinds of work are to be done. As it is possible to get different speeds to suit various sizes of emery wheels and for adaptation to work required, this becomes a valuable feature worthy of careful consideration.

LIGHT, HEAT AND POWER PRINCIPLES.—XI.

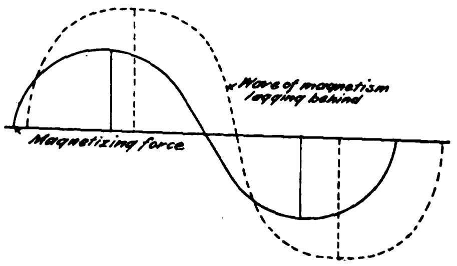
BY NEWTON HARRISON, E. E.

Weight of Transformer Iron and Losses.—All alternating current apparatus makes use of sufficient iron to constitute an item of great loss when the entire weight is considered in connection with the loss of power such weight represents. Although an old table, the following figures obtained from experimental data supplied by Prof. Ewing and used by Gisbert Kapp, can be referred to for the purpose of finding out the number of watts wasted per ton of iron and in consequence the horse power dissipated per ton as well:

Lines of force per square centimeter in the iron.	Watts wasted per ton of iron.	Horse power wasted per ton of iron.	Lines of force per square inch.
2,000	650	.87	12,500
3,000	1,100	1.48	18,750
4,000	1,650	2.21	25,000
5,000	2,250	3.02	31,250
6,000	2,900	3.89	37,500
7,000	3,750	5.03	43,750
8,000	4,450	5.97	50,000
9,000	5,550	7.43	56,250
10,000	6,650	8.90	62,500

It is not an unusual thing for central stations to have from 20 to 100 or more transformers attached to their circuits, weighing on an average of from 100 to 500 pounds or over, according to their capacity. This being the case, if the figures given are taken to represent the weight of iron, it is evident that 100 transformers with 100 pounds of iron apiece would weigh 10,000 pounds or five tons. At an average induction of 7,000 lines of force per square centimeter, or over 40,000 per square inch, the loss of power per ton would be about 5 hp. For 5 tons of iron the total becomes 5 × 5 = 25 hp.; quite an expensive item if calculated annually at the rate of $50 per annum per horse power, thus meaning a fixed loss of 25 × $50 = $1,250. In some central stations, supplying considerable electricity over scattered sections of a town or city, the number of customers may be so great that several thousand transformers are in use at once. At an average of only 50 pounds of iron apiece, 1,000 transformers would represent a total iron weight of 50 × 1,000 = 50,000 pounds or 25 tons. At the same rate per square inch for the lines of force the loss per ton of iron is 5 hp. This means a total annual loss of 5 × 25 = 125 hp., which costing $50 per annum, would mean a net loss of $6,250 a year. The loss of power in the primary and secondary coils is not considered in this estimate, but it would mount up as well to important figures. Though a great saving in copper is made in the transmission and distribution of electricity by means of a high pressure alternating current, a balance can only be properly struck if the iron losses and individual losses in the copper of each transformer are carefully considered.

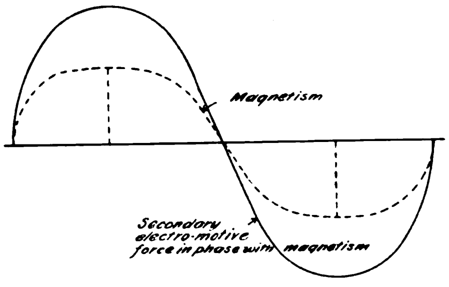
Lag of the Magnetism Behind the Magnetizing Force.—The application of a magnetizing force to the iron is not sufficient to instantly magnetize it. A certain interval of time elapses before the lines of force appear in response to the magnetizing force. Hysteresis causes this lag of the magnetism behind the magnetizing force. The result, therefore, of a magnetizing force applied to a piece of iron would be a magnetization curve a little behind the ampere turns creating the magnetism. The magnetizing force naturally follows the sine wave, for the obvious reason that the current and pressure are developed as sine waves. The magnetizing force simply consists of the coil turns and the current; it therefore rises and falls as a typical sine wave as well. But the magnetism will not develop in this manner; its growth and diminution are formed in the hysteresis curves, with the difference, however, that when the change occurs slowly the curve is of a square flat type, as shown in the illustration. It is also evident that the magnetism lags behind the electrical energy as found in the magnetic curve where it crosses the zero line to a degree



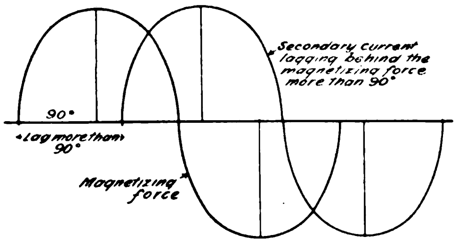
Relationship of the magnetizing force and magnetism.

dependent upon the responsiveness of the iron to slow or fast changes.

Influence of the Magnetism Upon the Secondary Coil.—The magnetism in the iron is the cause of the secondary developing its EMF. It is evident that the secondary EMF. is in perfect phase with the magnetism of the iron core. The degree of change represented by the rising and falling curve of magnetism is therefore an exact measure of the degree of change developed in the secondary coil in the way of electromotive force. The reason for this is found in the well-known fact that lines of force and turns which vary according to simple principles produce EMF. In this case the lines of force vary, but not as rapidly as the magnetizing force producing them vary. The coinciding of the rise and fall of the secondary EMF. with the rise and fall of the magnetism does not mean a current in the secondary which is in phase with its EMF. If the magnetizing force be plotted with its resulting EMF. in the secondary, and then the secondary EMF. be plotted with the current in the secondary, a greater difference of phase will naturally be found between the magnetizing force and the secondary current than can be explained by any other means than that of hysteresis.

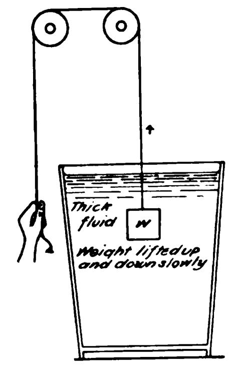


Relationship of the magnetism and the secondary EMF.

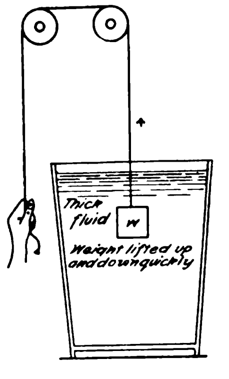


Relationship of the magnetizing force and the secondary current.

The Two Causes of Hysteresis.—From a physical standpoint hysteresis may be regarded as dependent in its manifestations upon two things: First, the degree of magnetization to which the iron is affected when the magnetizing force is applied to it; and second, the rate at which the magnetizing force is applied, withdrawn and reversed. This has been described under the title of static and viscous hysteresis by comparing it with a weight drawn up and down through a thick gelatinous fluid. To quote: "Apart from the fluid resistance, the work done in lifting the weight against gravity, say 100 times, is 100 times the work required to lift it once; but if fluid resistance comes into play, and if this varies as the square of the velocity of the moving body, then the total work done in lifting the weight through the fluid will be dependent also upon the rate at which the cycle is performed."



Simile to hysteresis with a low rate of reversal and strong field.



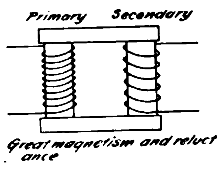
Simile to hysteresis with a high rate of reversal and strong field.

Transformer Efficiencies.—When the transformer is unloaded, that is, when the resistance of the secondary is that of an open circuit, the amount of energy wasted in the transformer is given by a formula as follows:

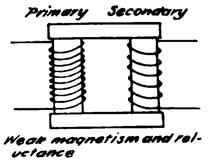
Waste of power =

$$\frac{1}{2} \times B^2 \times R_D \times \left(\frac{K}{4 \times \pi \times T_D}\right)^2,$$

where B = the lines of force per square centimeter in the core, R the resistance of the primary coil, K the magnetic reluctance (equal to $l \div \mu \times q$, where l = the length in centimeters, μ = the permeability of the iron and q = the cross-section in square centimeters), T_D = the turns of the primary coil, and π the value 3.1416. As this waste of energy is calculated from absolute units the results would be ergs, 10,000,000 of which are equal to 1 watt. The answer therefore divided by 10^7 will give watts, or if further divided by 746 will give horse power. It is evident from an examination of the formula that as the magnetization of the iron of the transformer increases the loss increases as its square. The lesson to be learned from this is that the transformer must be designed to operate at a low magnetization, when the lamps connected to the secondary are not in use. The other point of perhaps greater importanee is that the energy wasted is proportional to the square of the magnetic reluctance K. The less the reluctance therefore the less the value of the square of its value as indicated, and the less the watts wasted when the secondary is on open circuit. The expression is valuable, in showing how a transformer with iron too well magnetized will be the means of dissipating a great deal of power. A feature in transformer construction is therefore the necessary bulkiness of them in order to obtain efficiency. A low rate of magnetization and the best quality of iron are to be considered as dominating principles.



Efficiency low.



Efficiency high.

Construction of Modern Transformers for Light and Power.—The transformers manufactured for practical use in the field of light, heat and power are so constructed that their efficiencies vary with the load as follows:

1. Efficiencies of a 150 kw. transformer of an EMF. of 500 to 15,000 volts and alternations of 7,200 per minute at different points of load.

Full load efficiency = 97.5 per cent.
¾ " " = 97.4 " "
½ " " = 97.0 " "
¼ " " = 94.9 " "

Other items of information: Regulation with a non-inductive load is to within 1.5 per cent. With a load having a .9 power factor the regulation is to within 3.5 per cent.

2. Efficiencies of a 375 kw. transformer of an EMF. of 500 to 15,000 volts and 7,200 alternations per minute, at different points of load.

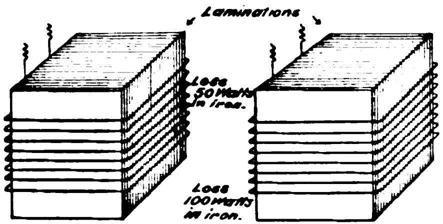
Full load efficiency = 98 per cent.
¾ " " = 98 " "
½ " " = 96.6 " "
¼ " " = 96.1 " "

Other items of information: Regulation with a non-inductive load 1.4 per cent. Load having a .9 factor 3.3 per cent. regulation.

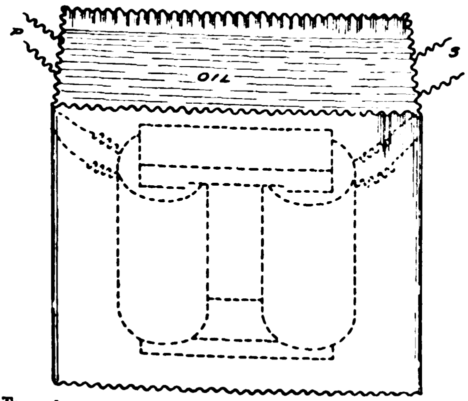
The primary and secondary coils are divided into a series of smaller coils, but of great depth of winding apiece. The insulation of each coil is complete and distinct from its neighbor, whereby the following advantages are secured by such construction:

First, it divides the total EMF. between several coils, reducing proportionately the strain within an individual coil; second, it divides the EMF. in a single coil between many layers, thus reducing the potential between adjacent layers; third, it enables the coils to be spread apart at the ends, so that a very large surface is exposed to the oil used as an insulator and cooling medium; it also provides ample radiating facilities besides thoroughly insulating the bent part of the coils; fourth, the transformer regulation is greatly improved; fifth, the winding may be readily connected in series or multiple, thus giving a wide range in EMF.; sixth, in case of damage to a coil another one may be substituted with little trouble and without it being necessary to return the transformer to its manufacturers.

The Aging of Transformer Iron.—A peculiar condition of affairs results from the aging of transformer iron. According to the records of one of the largest manufacturers in the country as quoted "It is not sufficient that the loss in a transformer be low when installed, for as is now generally known, much of the iron that has been used in transformers when subjected to the conditions prevailing in continued service is subject to a material deterioration, more or less rapid, with the result of a corresponding material increase in the iron losses. In some cases this increase has amounted to a doubling of the loss found in the transformer when first installed." The importance of this statement cannot be overestimated, because it is evident that a careful examination of the iron, from whatever source it may come, is absolutely necessary before it is used for transformer construction. It is therefore necessary to use all means that science can employ to select iron, which, though no better than that of other lots so far as permeability, coerciveness, etc., is concerned, is still superior, in that it does not deteriorate because of an inherently stable character when in practical use.



Comparative loss in iron through hysteresis when newly in service and when aged.



Transformer placed in a corrugated oil-filled case for insulation and cooling.

Cooling of the Transformer.—Corrugated exteriors are made to provide a greater surface and thus cool the contents of the transformer more rapidly. The transformer proper is placed in a cast-iron box which is filled with oil. The outside of the box is ribbed to facilitate the radiation of heat, or otherwise enlarged by means of corrugations, etc. The oil acts as a conductor in transferring the heat to the outside of the containing cases. The additional feature is that of connecting the outside of the case to a water circulating system to further facilitate its rapid cooling.

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COST OF FREIGHT BY ELECTRIC HAULAGE.

BY GEORGE E. WALSH.

The rapid extension of electric railways in the agricultural districts, and the construction of high-speed railways between large towns and cities, has brought the problem of handling freight by trolley into the foreground. The effort to develop the freight haulage side of electric railways has met with many obstacles, both from legislation and hostility of steam railroad companies, but fortunately most of these difficulties are being solved, and the legitimate field of operation in this respect is being exploited. The possibilities of developing agricultural and rural districts by handling freight by electric lines are fully recognized by most companies, and many owners of suburban property are anxious to co-operate with the railway companies in improving their freight handling facilities.

In the Eastern and Middle States it may, therefore, be said that a complete change of opinion regarding the handling of freight by electric lines has been brought about in the past year or two. Before 1900 the hostility to the roads was general. Municipalities refused to grant franchises to the railway lines permitting them to handle freight, and State legislators strictly opposed any attempt to amend charters that increased the rights of the electric lines. The steam railroad companies steadily refused to make any traffic agreement with the electric lines. In some instances this was so radical that important business was lost. Where electric railway feeders helped to increase the traffic of the steam roads the latter refused absolutely to receive freight direct when delivered by the former.

Such hostility could not continue indefinitely. Gradually the steam roads are facing the problem frankly, and freight traffic arrangements are being made in the East with electric lines which are not openly competing with them on parallel lines. Looked upon as feeders the electric roads are accepted as friendly corporations and the trunk lines make provisional agreements to handle freight delivered to them. Likewise State legislation is growing less hostile, and charters are being granted to lines operated by electricity to act as freight carriers in addition to their regular passenger work. Towns and cities instead of refusing the rights of their streets for electric freight haulage are more and more inclined to recognize that under certain restrictions this is a great benefit instead of a detriment to the municipality's growth. The rapid growth of interurban electric lines has demonstrated the superiority of electric freight and express traffic for certain lines of goods, and to-day where such service is in existence business is greatly improved.

There is certain bulky freight which may never prove profitable or desirable for electric railway carriage. Such heavy, bulky freight is the legitimate traffic of the steam roads even where electric lines parallel the former. This is well illustrated in the work of the several freight-carrying interurban roads in New York State. The freight traffic carried on the Albany, Rochester and Hudson Valley interurban electric lines has steadily increased in the past few years, but it is composed chiefly of small packages and merchandise rather than of heavy freight.

Express freight in particular has adapted itself to the interurban electric lines. Such freight can be carried cheaper and with much greater dispatch by the electric roads than by the steam. By virtue of their right to use the city streets, the express freight can be delivered nearer the consumer than it will ever be possible for the steam roads. Frequent delivery stations along the route of the electric roads in the city make it very simple to handle express expeditiously. The express freight business in 1903 reached considerable proportions in the East. The Hudson Valley Electric Railway carried upward of $22,190 worth of express matter that year some 54,842 car miles, making an average of receipts per car mile of 40 cents. Since then this traffic has just about doubled. Prior to that there was little accommodation for local freight traffic between the towns and villages tapped by the road. The charges are considered by all shippers much less than averaged by steam lines, while the accommodations have greatly stimulated suburban growth and development. A number of plants dealing in small articles have since decided to locate along the line of this railway simply through the accommodations obtained in handling goods.

A similar story can be related of the Albany, Rochester and Newburgh lines. The latter is the smallest of the three, but it carried in 1903, the sum of $12,881 worth of freight and express packages over 16,516 car miles. The receipts per car mile amounted to 78 cents. This line runs through a farming region, and has few large villages anywhere along its route, and it must therefore depend more upon freight than upon express packages. Since its construction, the country has steadily developed, and farmers have been induced more and more to ship their produce by it. Formerly, milk, fruits and vegetables intended for Newburgh and New York City were carted over many miles of rough country road to the steam lines, and often produce was lost through lack of facilities for handling it. Anything except heavy farming, such as grain, hay and produce that would keep indefinitely, was not attempted by the farmers five miles back from the city of Newburgh.

To-day all of this has changed along the line of the electric railway. Eggs, milk, poultry and choice fruits and vegetables are raised on scores of farms, which were formerly considered useless for this work, owing to the distance from market and steam roads, and new profitable farming industries are steadily increasing. The farmers are depending more and more upon the electric railway to ship their produce to market. Only very heavy, bulky goods are carted by the wagons, and the railway has recently been considering arrangements to handle even such goods as hay, grain and winter potatoes, apples and cabbages.

With the electric railways the cost of transportation of farm produce is largely a matter of meeting certain fixed charges and operating expenses. With the railroads, and especially the small, short-haul lines, the transportation charges are often the result of years of habit without any consideration of existing conditions. Instead of developing agricultural regions within a radius of 5 to 20 miles of a large city, extortionate steam road charges tend to reduce production and give the distant competitor more advantages. The electric railways running between cities and towns endeavor to develop the agricultural possibilities of their territory to increase the local freight traffic. Farm products are thus more evenly distributed, and are not all shipped in bulk to one great market where over-supply and congestion causes loss to the producer. It is commonly claimed that fresh farm products are more difficult to secure, and at higher rates, in the small village and town in the heart of agricultural regions than in the large cities. This is due to the efforts of the steam roads to carry products over the longest possible distance. The local interurban tends to correct this, and to supply markets along its route, charging transportation rates according to the number of miles carried.

Up to date the electric railways have not entered to any extent into the coal carrying business. Under present conditions the steam roads refuse to transfer their coal cars to the electric lines, but this will not last long. The Eastern steam roads are building their own electric lines, which will naturally handle loaded coal cars. It is then a short step to general transfer of coal cars from one electric line to another. Statistics show that the prohibitive cost of coal to-day in many inland districts is due almost entirely to the fact that breaking bulk adds enormously to the price. The long cartage over country roads, furthermore, makes coal as a winter fuel a pretty expensive luxury. There are electric railways to-day equipped for distributing this important commodity without any of the present disadvantages of breaking bulk. Not until the steam roads either change their policy or buy up intersecting electric lines will this problem be properly solved.

Last year the Altoona & Logan Valley Electric Railway carried upward of $35,000 worth of freight and express goods, and the Lehigh Traction nearly $40,000. Two other Pennsylvania roads, the Lancaster and Harrisburg Traction, nearly equalled these in their freight handling. These lines run through both mining and agricultural regions. The products of the mines are practically controlled by the large steam roads, and very little of this class of freight was handled by the electric lines. An examination of the goods, however, show that many new industries only indirectly connected with mining have sprung up along the lines, which have added greatly to the business. Mine products always show an enormous waste, but their cost of transportation to manufacturing regions, makes it impossible to utilize them. A number of concerns interested in chemical and electro-metallurgical work have located near the Pennsylvania mines in the past few years, and their products form quite a considerable bulk of traffic for the electric lines. It is a question whether they would have located there had not electric railways proved accommodating and comparatively cheap in handling freight as well as passengers.

According to present rates of charges by the steam railroads the electric lines could make large profits. Most of the electric lines in the East, however, charge much lower rates even when not competing openly with parallel steam roads. Thus on most of the short steam lines in the East the average gross freight receipts are $650 per mile of track per annum, although in many cases this runs up to $2,000 to $5,000 of gross freight earnings per mile of track per annum, according to the location and nature of the freight handled. An electric railway earning this amount per mile for freight would certainly pay huge dividends upon its stock.

The question of developing the freight and express service of electric railways is now receiving the attention of the best managers and operators in the country. Heretofore the roads engaged in this business have depended chiefly upon the freight produced and consumed along their routes, but the effort is being made to handle through trade between cities in bulk. A good deal of the freight transferred from the steam to the electric roads without breaking bulk would greatly benefit consumers and shippers. The steam roads in a few of the large cities have begun to recognize this fact, and several contracts are now in effect which permit the electric roads to take freight in bulk direct from steam roads' terminals. The Brooklyn Heights Electric Railroad two years ago handled upward of $75,000 worth of freight and express, and the present year has found the Brooklyn Rapid Transit and the Metropolitan traction lines fully equipped for freight and express service. These two systems have handled more express freight the past year than any two of the large express companies combined for local delivery. This end of the service has also proved one of the most profitable. The express cars reach every freight depot in the city, and, receiving the express goods direct, distribution is rapid and satisfactory. Besides facilitating delivery of express goods, the electric delivery cars greatly reduce the amount of trucking on the city streets.

The paralleling of most steam roads by trolley lines in the East, and the effort of the latter to secure freight as well as passenger traffic, have caused not a little friction, but wiser methods than rate wars may in time prevail. A discrimination between the character of the two roads is already bringing about a healthier tone. As the steam roads are better able to carry long-distance passengers, so in the freight service they have the facilities for carrying heavy and through freight traffic which the average electric line does not possess. There can be no present competition in these two distinct lines. The electric roads are not provided with expensive freight terminal facilities for handling heavy traffic, but they are equipped for quick delivery and distribution of light and costly merchandise packages. It would be much to the advantage of the railroads to recognize this fact and co-operate with the electric lines for handling light express packages and higher class merchandise. Rapidity of delivery of such goods tends to increase business and stimulate traffic, and this can best be accomplished by the electric lines which have the right of way in the city streets.

Likewise short suburban delivery is the particular field of the electric lines. Here it is impossible for the steam roads to offer any opposition. The day of the slow wagon delivery in the suburban and country districts is past. The distribution of goods to the different small villages along the electric railway's route is a matter of simple business shrewdness. The steam railroads have to some extent recognized the fact that high-class merchandise freight can be handled easier and cheaper by electricity than by steam, and they have started to equip many short lines and feeders with electricity for this work. The development of the electrical short haul and light express service in connection with several of the Eastern trunk lines is thus quite phenomenal, and the future extent to which the service will go is beyond present prediction.

Right of Electric Companies to Condemn Land.

At Utica, N. Y., Supreme Court Justice Maurice L. Wright rendered a decision upholding the constitutionality of the law which gives to electric light and power companies the right to condemn lands which may be required in the attempts to furnish municipalities with light and power. The East Creek Electric Light and Power Company sought to acquire the lands of Norman Loucks and asked for the appointment of a commission to assess the damages. Loucks resisted, and attacked the constitutionality of the statute. Justice Wright holds that the Legislature has the power to invest in companies providing the municipalities with a supply of electricity for power and lighting the same rights that are held by companies engaged in furnishing cities and towns with water.

Whew! $150,000,000 Is All the Bell Company Needs Just Now To "Expand!"

The American Telephone & Telegraph Company (Bell), in order to secure additional capital necessary "in the large expansion of its business," contemplates the issue of $150,000,000 convertible bonds, such bonds to be sold from time to time as the needs of the concern may require. A special meeting of the stockholders has been called for December 21 at which they will be requested to vote upon the acceptance of the scheme.

How is $150,000,000 for high-water-mark? Evidently "somebody is frightened."

An Electrician Wanted.

The United States Civil Service Commission announces an examination on January 3, 1906, to secure eligibles from which to make certification to fill a vacancy in the position of electrician, at $1,000 per annum, in the quartermaster's department at large, Vancouver's Barracks, Wash., and vacancies as they may occur in any branch of the service requiring similar qualifications.

New York's Electrical Show.

At the electrical show, to be held in Madison Square Garden, New York City, from December 12 to 23, about every kind of electrical device in use up to date will be shown. There will be a model of the Williamsburg Bridge showing how Commissioner Woodbury burns waste and rubbish in an electrical incinerator and lights the bridge thereby. In the center of the Garden a "theaterphone" is to be rigged, and wires from it will be strung to the stages of various theaters. Visitors at the show will be enabled thereby to hear what is going on at the theaters.

Proposals Invited.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until December 19 for furnishing Eastern Navy Yards with the following electrical material: Schedule 260, arc lamp carbons and globes, rubber-covered wire, conduit and fittings, tape, sockets, switches, lamp cord and miscellaneous electrical supplies; schedule 261, buzzers, wire, annunciator drops, conduit fittings, miscellaneous supplies; schedule 623, motor generator set. Blank proposals can be obtained at the Navy Pay Office in New York or upon application to the Bureau at Washington.

ELECTRICAL PATENT RECORD

LETTERS PATENT ISSUED NOV. 28, 1905

Electric Railways and Appliances.

805,568. Trolley-Base. Henry R. Lockhart, Westmount, Canada. Filed July 23, 1904.

805,572. Trolley-Wheel. Alexander H. Mathesius, Brooklyn, N. Y. Filed May 24, 1900.

805,827. Railroad Signal-Circuit. Eugene W. Vogel, Chicago, Ill., assignor to the Railroad Supply Company. Filed Sept. 20, 1901.

806,035. Electric Signaling and Electropneumatic Train-Control System. John A. Whyte, Toronto, Canada. Filed Sept. 2, 1904.

Electric Lights and Appliances.

805,574. Electric Gas-Lighter. Joseph Mlada, Manitowoc, Wis. Filed March 21, 1905.

Electrical Machinery and Apparatus.

805,499. Electric Drill. Stephen D. Stoycheff, Toledo, O. Filed June 26, 1903.

805,505. Automatic Regulator for Electric Circuits. Montgomery Waddell, New York City. Filed June 28, 1904.

805,509. Electric Cut-out. Willes P. Wright, Blandinsville, Ill. Filed June 13, 1904.

805,547. Armature for Electrical Machines. William T. Hensley, Boundbrook, N. J. Filed March 25, 1905.

805,725. Controlling Device for Electric Generators. Moritz von Hoor, Friedrich Reinitz and Leopold Stark, Budapest, Austria-Hungary. Filed April 17, 1901.

805,748. Speed-Regulator for Power Transmission. Charles Pfanschmidt, Chicago, Ill., assignor to the Vibrassage Company, same place. Filed May 3, 1905.

805,952. Electrical Muscular Exercising Machine. Robert O. Hammond, Buffalo, N. Y., assignor to Josiah S. Andrews, same place. Filed May 23, 1905.

Telephones and Telephone Apparatus

805,901. Telephone Exchange System. Henrik T. Cedergren, Stockholm, Sweden. Filed Jan 28, 1902.

805,557. Electric-Current Generator. William Kaisling, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company. Filed May 31, 1904.

Miscellaneous.

805,439. Lightning-Arrester. Arthur J. Berry, Marion, O. Filed Feb. 25, 1905.

805,448. Magnetic Seperator for Ores. Henry F. Campbell, Melrose, Mass.; Jeanette L. Campbell, executrix of said Henry F. Campbell, deceased. Filed Jan. 20, 1904.

805,501-502. Method of Producing Chemicals in Electric Furnaces. Edward R. Taylor, Penn Yan, N. Y. Original application filed April 4, 1901. Renewed Feb 8, 1904.

805,619. Electric Signaling System. William S. Aungst and Arthur S. Aungst, Alliance, O., said Arthur S. Aungst assignors to said William S. Aungst. Filed March 20, 1905.

805,694. Method of Electrostatic Separation. Philip H. Wynne, Boston, Mass., assignor to Charles Henry Huff, Brockton, Mass. Filed Aug. 2, 1904.

805,735. Rear-End Contact Telegraph Key. Samuel S. Lefley, Florinel, Pa. Filed Aug. 26, 1903. Renewed July 13, 1905.

805.783. Electric Furnace. John S. Dorian, Niagara N. Y., assignor to Cora N. Dorian, same place. Filed March 27, 1905.

805,788. Electric Strain-Insulator. Samuel L. Foster, San Francisco Cal. Filed Jan. 16, 1905.

805,795. X-Ray Tube. John O. Heinze, Jr., Lowell, Mass. Filed March 16, 1905.

805,854. Magnetic Ore-Separator. Eric Hedburg, Joplin, Mo., assignor, by mesne assignments, to the American Reduction Company, Chicago, Ill. Filed Jan. 15, 4904.

806,018. Electromagnetic Relay or Sounder. Thomas M. St. John, New York City. Filed April 12, 1905.

806,039. Electric Heater for Oil-Wells. James E. Williamson and Charles E. Collins, Allegheny, Pa., assignors, by mesne assignments, of one-third to Amalia S. Connolly, Pittsburg, Pa. Filed Jan. 23, 1896.

806,052. Receiver for Wireless Telegraphy. Henry S. Blackmore, Mount Vernon, N. Y. Filed May 8, 1901.

THE TELEPHONE WORLD.

National Interstate Association Wants Maps.

Every Independent exchange manager in the United States is urged to send the National-Interstate Telephone Association of Cleveland, O., a map of the toll and long-distance lines owned or controlled by his company. In the work of compiling maps the association has been handicapped by not receiving the complete information necessary to show all the Independent lines in the different States. If all telephone managers will promptly comply with this request it will greatly simplify the making of these maps, which are of great value and benefit to every one interested in Independent work. It is to be hoped that every assistance will be given the association, and that maps of every State can be published showing the wide ramification of the Independent movement.

News from Birmingham, Ala., states that the People's Home Telephone Company will be able to re-establish its business much sooner than had been expected. Its switchboard. which was recently destroyed by fire, will soon be replaced by one of the Stromberg-Carlson manufacture, which will enable the company to put one-half of its telephones into service in a short time, and it will also give connection with the sub-stations in the suburbs of Birmingham at the same time.

Several telephone companies have recently been organized in Iowa, including the Caldwell Mutual Telephone Company of Exline, the Sheldon Telephone Company, capitalized at $15,000, the Terril and Lake Center Telephone Company of Terril, and the James Telephone Company, located at James, with Henry Junck president, and Frank Woolworth, secretary and treasurer.

The last link in the long distance lines of the American Telephone & Telegraph Company from Pittsburg, Pa., to Grafton, W. Va., a distance of about 109 miles, has been completed. The line follows county roads all through Fayette County, coming from Pittsburg by way of Perryopolis.

A special meeting of the stockholders of the Southern Bell Telephone & Telegraph Company has been called for December 13 to vote on a proposition to increase the capital stock of the company from $1,000,000 to $30,000,000.

The Pleasant Valley Telephone Company, a new organization, lately began work constructing a line south from Sauk Center, Minn. Its object is to connect the rich farming district in Pleasant Valley with Sauk Center.

A telephone line from McEwan, Tenn., through Humphreys County to points on Hurricane Creek is in course of erection. Dr. Robertson and P. J. Fuqua are the prime movers in the enterprise.

The Home Telephone Company of Mobile, Ala., has begun the work of putting down 300,000 feet of wires underground for use in the system.

Telephones Wanted by Long Island Farmers.

One of the peculiar results of the recent development of suburban and rural Long Island is the rapidly growing demand for telephones on the part of farmers. This is not confined to the more up-to-date farmers in the immediate outskirts of the metropolitan centers, but has extended to the more remote districts. A man who has just returned from a tour of inspection in Suffolk and Nassau Counties said recently:

"There has been a marked demand for telephones among farmers out on Long Island, and, while at first sight, this statement may seem strange, the reasons for the demand are perfectly rational, when attention is given to the great changes that have taken place on Long Island in the last four years.

"The demand is not specially for the various local telephone services, but for the regular metropolitan telephone connections, and especially for the long-distance lines. The demand is being forced upon the farmer by circumstances. It is the epicurean market dealer in Manhattan and Brooklyn that is forcing the long-distance telephone on the farmer. In his search for the most tempting edibles, the club and high-class chef encourages the specializing of vegetable raising among farmers, and the one who can raise a strange variety of vegetable, is sure of a steady demand for it, and payment of fancy prices from the city chef.

"This is where the long-distance telephone becomes imperative to the farmer who makes a specialty of raising new varieties and forms of vegetables, and this is the reason why so many regular service telephones are being installed in lonely, out-of-the-way farms out on Long Island."

The Washington & Monroe Telephone Company of Marietta, O., capitalized at $5,000, was lately incorporated by E. D. Amos, William Kette, Cyrus McHugh, W. J. Moore, C. A. Amos, B. C. Cline and J. O. Swallow. The incorporators will establish a line connecting New Matamoras, Woodford and other cities in those two counties.

The old ordinance granted the New State Telephone Company of Sault Ste. Marie, Mich., several years ago, and under which it is alleged the Michigan Telephone Company has been operating, has been repealed by the common council of that city. It is held that the Bell Company had invalidated whatever right it might have had under it by charging a higher rate for telephones than the franchise called for.

W. M. Denton, owner of the telephone franchise at Willacoochee, Ga., has begun the work of putting in the system. It is understood that the line will be extended to McDonald, connecting Pinebloom, Leliaton, Kirkland, Pearson and McDonald. With this work complete there will be telephone service in every section of Coffee County.

A lively telephone rate war is on at Rockwood, Tenn. The citizens are opposing a plan of the Cumberland Telephone Company to increase the rates for service.

Automatic Telephones.

At a meeting of the board of directors and the executive committee of the Consolidated Telephone Companies of Pennsylvania, of which the new telephone company of Wilkes-Barre is a part, held in their offices in Allentown, orders were placed for the installation in that city of an automatic telephone exchange of 4,000 lines, and similar exchanges of smaller capacity in Hazleton and Emanus.

The automatic system will embrace all the latest features in this, the highest development of telephony, since its inception.

The plant in Allentown will alone cost nearly $75,000, and will be installed in from three to four months. The Hazleton exchange will cost $25,000.

The new exchanges will be supplied by the Automatic Electric Company of Chicago, which has supplied exchanges of large capacity to many of the leading cities.

Harper, Kan., it is claimed, has more telephones installed in homes and business houses than any other city in comparison to its size in either Missouri or Kansas. There are 400 telephones in the place, which has a population of not more than 1,600. There are about 300 houses in the town, including places of business. There is an average of one telephone in each residence, and two telephones in each of more than one-half of the business houses.

The Central Home Telephone Company, capitalized at $5,000,000, was incorporated last week in Dover, Del. The incorporators are Edwin L. Barber, of Wauseon, O.; Joshua D. Powers, Louisville; John C. Monteleith, Bloomington, Ind., and James E. Bergen, Nanticoke, Pa. The company, it is said, will operate in Western Kentucky and Tennessee.

A deal has been closed whereby the Northwestern Telephone Exchange Company of Minneapolis, Minn., bought of Dr. F. W. Epley, the telephone exchange at New Richmond, Wis., its franchise, which runs until September, 1906, and its tributary rural lines. The transfer took place December 1.

A company has been formed at Mountain View, Ark., for the purpose of putting in a local telephone exchange. The officers are: J. L. Lancaster, president; Cebern Brooks, secretary; S. S. Brewer, treasurer.

A called meeting of the board of mayor and aldermen of Pulaski, Tenn., lately put a quietus on the telephone agitation there, by the withdrawal of all propositions from the Long Distance Company and the abandonment of its efforts.

The Billings & Red Rock Telephone Company of Billings, Okla., with a capital stock of $30,000, has been incorporated by Roy Henry, Rozelle Henry and Nannine J. Carter, all of Billings.

The Vicksburg & Yazoo City, Miss., Telephone Company reports to the Railroad Commission that its receipts for the last quarter were $195.80; operating expense, $132.65; net revenue, $63.15.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Atchison, Kan.—A contract has been let by the town board of Rushville for an electric light plant to furnish lights to the town, and also to furnish electricity for home consumption and manufacturing purposes. Work has begun on the plant.

Aurora, Ill.—The city council has under consideration the building of an electric lighting plant.

Beaumont, Tex.—R. C. Duff, A. Landry, John H. Brooks and others, are organizing a company to operate an ice factory and electric light plant.

Cheyenne, Wyo.—At a recent meeting of the city council, Mayor Collins decided to establish an electric plant in Basin, and a 25-year franchise for that purpose was granted.

Edwardsville, Ill.—This city and the McKinley Syndicate are arriving at a conclusion on the latter's petition for a franchise to operate an electric power and light plant in this city.

Elgin, Ore.—Messrs. Spencer and Sappington have purchased the electric light plant in this city from H. V. Gates & Co.

Forest, O.—The town council has awarded a contract for the lighting of this place by electricity.

Fremont, Neb.—The city council has decided to buy four 150 hp. horizontal boilers and a tubular 500 hp. heater for the municipal electric light and water station.

Glen Gardner, N.J.—At a regular meeting of the Lebanon Township Committee, the Lebanon Electric Light Heat & Power Company made an application for a franchise to erect poles and suspend wires for the purpose of lighting the streets and alleys of Lebanon Township. The president of the company is Charles V. O'Donnell, and Joseph C. Farr is the secretary.

Key West, Fla.—The Consumers' Ice & Cold Storage Company, of which F. H. Ladd is president, has applied for a franchise and will install an electric light plant.

Lawrence, Kan.—At a special meeting of the city council the contract for lighting the city was awarded to the Lawrence Electric Light Company, whose bid was $5 a month per lamp for 25 lights to burn all night, and $4 a month per light for 65 lamps to burn until 12:30. The lights are to be 2,000 cp., and the work of installing the system is now being done.

Litchfield, Ky.—The new city council gives assurance of an electric light plant and waterworks.

Muskegon, Mich.—The Muskegon Heights council has been considering the advisability of installing an electric lighting and water plant and will report favorably on the proposition at its next meeting.

Oakesdale, Wash.—The town council has granted an electric light franchise to the Moscow Light & Power Company of Moscow, Ida. The power company has the privilege of installing a plant here or bringing in power from outside.

Ozark, Ark.—Local parties contemplate installing an electric light plant and waterworks. R. M. Adams can give information.

Passaic, N. J.—This city is agitating the question of a municipal electric light plant.

Red Wing, Minn.—Capitalists from Detroit have secured control of the gas and electric light plants of this city, and will expend a large sum of money improving and developing them. The syndicate now owns 18 such plants. P. C. Thompson, F. A. Platt, Ralph L. Aldrich and A. E. F. White compose the syndicate, which will take possession January 1. The local management will remain the same as before.

Springdale, Ark.—Spencer Owen has secured a franchise to construct and operate an electric light plant.

Thomasville, Tenn.—The citizens at a special meeting voted to incur a debt of $30,000 for the purchase of a municipal electric light and power plant. The plant to be purchased is that of the Thomasville Electric Light Company.

Twin Valley, Minn.—Frank Magnuson has decided to install a new electric lighting plant here.

Watertown, Tenn.—A movement is being planned to give this town electric lights in the near future. No definite plans have been formed, but live interest is being shown and the city hopes to soon be enjoying the benefits of a complete light plant.

STREET RAILWAYS.

Avondale, Pa.—Tracks are being laid for a trolley road from here to West Grove.

Douglass, Tex.—Early in the coming spring electric cars will be run in this city.

Evanston, Ill.—Another electric line for this city that will tap the West Side and run north to Wilmette and south to the proposed Ravenswood extension of the Northwestern Elevated Railroad has taken form in a draft of an ordinance which was presented to the city council recently.

Five Lakes, Mich.—The electric line surveyors are now at work here.

Macon, Ga.—The Macon Railway & Light Company will expend $50,000 in enlarging its plant and power houses.

Marshall, Mo.—A proposition is now under consideration to build an electric railway between here and Sedalia.

Mt. Carmel, Pa.—The construction of a trolley line from this city to Locust Gap is now under way.

Muncy, Pa.—A charter has been granted by the State Department for the construction of an electric railroad from this city to the upper end of Hughesville, a distance of about six miles.

Paxton, Ill.—An electric railroad is expected to run through this city, starting at Danville, and running to Pontiac.

Roosevelt, Okla.—A charter has been granted the Wichita Mountain Traction Company of Hobart to build 50 miles of electric line from here to Apache, costing $250,000.

Syracuse, N. Y.—General Manager John J. Stanley, of the Rapid Transit Company, is anxious to have the proposed connection between the Solvay and West Genesee street electric lines as soon as possible.

Zanesville, O.—It is stated that the Ohio Power Company of this city has amended its charter so as to permit it to construct an interurban line connecting Newark. also to furnish light and power for the cities named.

POWER PLANTS.

City of Mexico, Mex.—Preliminary arrangements have been made for the installation in the mining district round about Parrel and Minas Nuevas, Mexico, of a mammoth power plant to utilize the waters of the surrounding mountains in creating electric power for a large number of mines. A large tract of land has been bought, and it is proposed to organize a Company with a capitalization of $10,000,000 to build and equip the plant. American capital will be given opportunity to secure control of this great enterprise.

Huntsville, Ala.—Representative Wm. Richardson, of the Eighth Alabama District, will introduce in the approaching session of Congress a bill granting a large Philadelphia electrical concern a franchise to develop the power of the Mussel Shoals in the Tennessee River. The engineers of the company have reported that there is enough power at the shoals to supply every city within a radius of 200 miles with the electricity it requires as well as to light every farm-house within that territory.

BIDS WANTED.

Abbeville, La.—Bids addressed to George W. Summers, secretary of Abbeville, will be received up to 3 P.M., Monday, December 18, for furnishing material and doing the work necessary for the construction of a waterworks and an electric light plant. Material and work includes the following: Brick buildings, pumping engines, boilers, steel tower and tank, cast iron pipe, hydrants and valves, automatic engines, direct current generators, electric wire and pole line material, machinery erection, pipe laying, drilling wells, sewer material and construction. Specifications for the above will be furnished upon application to W. Mackintosh, engineer, Abbeville, and plans can be seen at engineer's office, in this city. Bids for construction work must be accompanied by certified check for 10 per cent. of the amount of the bids. The right is reserved to reject any or all bids. J. R. Leguenec, mayor.

Cincinnati, O.—Bids will be received about January 15 for a power plant for the new Fourth Street Hotel. This part of the improvement will cost in the neighborhood of $100,000.

Washington, D. C.—Sealed proposals will be received at the office of the Building Committee, United States Department of Agriculture, this city, until January 5, 1906, and then opened for the installation of the electric wiring and conduit system of two laboratory buildings for the United States Department of Agriculture, in accordance with the drawings and specifications, copies of which may be obtained at the office of the Building Committee, United States Department of Agriculture. All applications must be accompanied by a certified check for $50, made payable to the disbursing clerk of the Department of Agriculture, which checks will be retained until the return of the drawing and specifications. B. T. Galloway, chairman.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 17⅞@18c.; Lake 17¾@18c.; casting, 17½@17¾c.

Brooklyn Rapid Transit was the weakest of the tractions on Monday, declining 2 per cent.

The Atlantic Telephone Company now offers to pay New York City $7,750,000 cash for a franchise.

It is reported that the Chicago Subway has secured a loan of $3,000,000 from Kuhn, Loeb & Co. to carry on construction work.

The West End Street Railway Company of Boston has declared the regular semi-annual dividend of 4 per cent. on its preferred stock, payable January 1.

At the annual meeting of the stockholders of the Metropolitan Street Railway Company of New York on Monday the retiring board of directors was re-elected.

The General Electric Company has declared the regular quarterly dividend of 2 per cent., payable January 15 to stockholders of record December 16.

Advices from Albany, N.Y., say that more than 99 per cent. of the total $5,000,000 outstanding stock of the United Traction Company have been deposited within the time limit.

The Chicago City Railway Company has declared the regular quarterly dividend of 2½ per cent., payable December 30. Books close December 12 and reopen December 18.

The Keystone Telephone Company of Philadelphia reports that from July 1 to October 31 its gross earnings were $264,804; net earnings, $123,668; fixed charges, $71,527; surplus, $28,325.

The transfer books of the American Telephone & Telegraph Company, for purposes of the special meeting to be held December 21, will be closed from December 14 to December 21, both days inclusive.

Directors of the United Railways & Electric Company of Baltimore have decided not to pay at the present time the December coupon on the cumulative income bonds, this being the fourth consecutive coupon in arrears.

The Auburn & Syracuse (N.Y.) Electric Railroad Company, having paid 4 per cent. on its preferred stock the last fiscal year, has increased its dividend rate to 5 per cent. It paid 1¼ per cent. on November 1 for the quarter ending September 30.

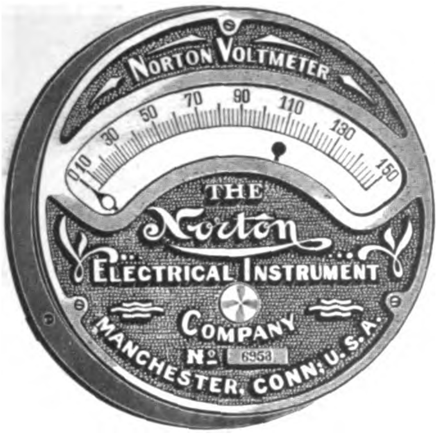
A report from Chicago says that National Carbon Company's net earnings this fiscal year (ending January 31) will be nearly $1,000,000, an increase of $150,000 over the preceding year, after usual depreciation, etc. This will be equivalent to 5¼ per cent. on the common stock, which will probably receive another dividend of 1½ per cent. early next year. During the company's seven years' existence it has written off $1,400,000 for depreciation.

Eastern interests in the Chicago Traction properties are looking for developments during the next few weeks. It is expected that the ordinance, which has been drawn up, will be passed by the common council of Chicago and vetoed by Mayor Dunne. The franchise case comes up in the United States Supreme Court on January 2. The controlling interests in the property feel reasonably sure of a decision in their favor. If they do win they will be in a much stronger position to dictate with respect to any subsequent ordinance that may be presented. If the company fails in the Supreme Court the controlling interests think that an ordinance, such as is now under consideration, should be regarded fair.

ELEOTRICAL STOCK QUOTATIONS.

Name.	Closing price Dec. 4
STREET RAILWAY STOCKS.	
New York City.	
Broadway and Seventh Avenue	241
Interborough Rapid Transit	212
Manhattan Elevated Railway	163
Metropolitan Street Railway	118⅛
Metropolitan Securities	73
Ninth Avenue	197
Third Avenue	123
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	83⅝
Brooklyn City Railway	239
New Orleans Railway	38
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	83
Philadelphia Traction	101
Union Traction	62⅝
Boston.	
Boston Elevated	154
Massachusetts Electric Companies, com	15¼
do. do. do. pref	59¾
West End Street, com	98
do. do. do pref	113½
Chicago.	
City Railway	192
North Chicago	83
Union Traction, com	10⅛
do. do. pref.	38½
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	20
do. pref.	62
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	15½
do. do. pref.	18
Westinghouse, com	174⅛
do. pref.	190
General Electric	183¼
Boston.	
Edison Electric Illuminating	289
General Electric	183¼
Westinghouse Electric & Mfg., com	85½
do. do. do. pref.	100
Chicago.	
Chicago Edison	161
National Carbon, com	78
do. do. pref.	116
Philadelphia.	
Electric Company of America	11⅛
Electric Storage Battery, com	81
do. do. do. pref.	81
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	132¼
Western Telephone Company	13¼
New England Telephone Company	134
New York.	
American Telegraph & Cable Company	93
Commercial Cable Company	210¼
Mexican Telephone Company	1⅝
New York & New Jersey Telephone Company	172½
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92⅛
Chicago Telephone Company	138
MISCELLANEOUS STOCKS.	
Chicago Subway	49⅛
Otis Elevator Company	68
Standard Underground Cable	..
Twin City Rapid Transit	114

NORTON SWITCHBOARD INSTRUMENTS.


NORTON VOLTMETER
10 30 50 70 90 110 130 150
THE Norton ELECTRICAL INSTRUMENT COMPANY
MANCHESTER, CONN. U.S.A.

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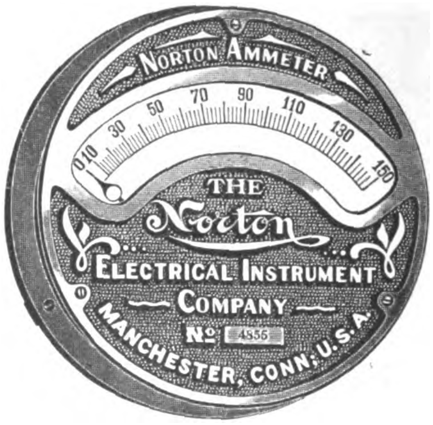
0 to 5 volts.
0 to 750 volts.
0 to 10 amperes.
0 to 1500 amperes.


NORTON AMMETER
10 30 50 70 90 110 130 150
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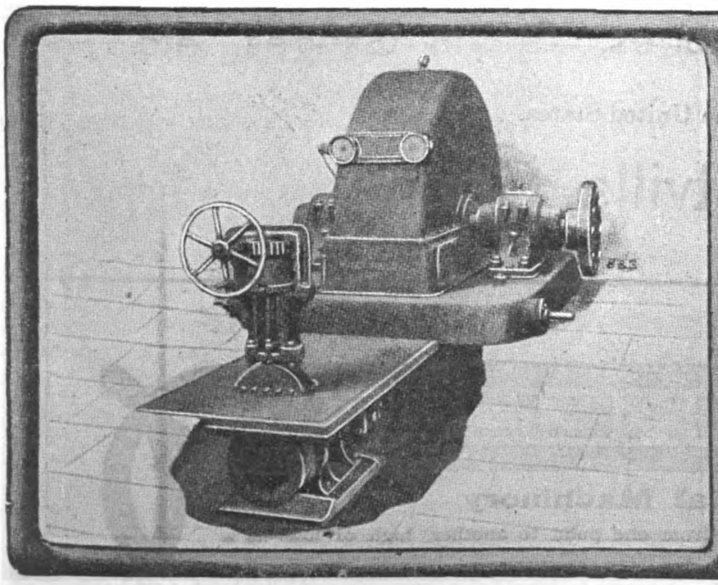
DIRECT CURRENT.



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ELECTRICITY.

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EDITORIAL NOTES.

Low Fares and Electric Traction.

Though not a new idea, the direct dependence of he public for relief from high fares rests upon the development of electric lines parallel to those demanding exorbitant rates. But the high charges of steam roads in certain localities is not necessarily an effort to gouge the public. It is essential that a rate be set which will net a profit, and this attempt is always the basis for criticism. But the point of importance is this: that if a local steam line is operating under such conditions that its transportation charges must be high in order to show profitable runs, then either the fare must be lowered in spite of claimed deficits or the road shut down entirely. It is inevitable in such a case for an electric road to parallel the steam line, and offer the public the same transportation at less cost. The meaning of this transaction is simply this—that to practical railroad managers transportation is like anything else which may be sold. The merchants competing for supremacy try conclusions with each other by variations in price. In the same manner rate wars have occasionally broken out all over the country between the different roads, perfectly similar to the steamship rate war recently ended among the transatlantic systems. When public sentiment is aroused over certain charges made for commodities or transportation, regarding them as excessive, the simple remedy of competition is always at hand as a weapon of defense.

In this respect electricity has served as the heavy fire gun. The steam roads' far-sighted managers see in the electric car and locomotive the future of all traction systems, whether short or long. They cannot fail to recognize the inevitable signs of transformation in railroad conditions—which will sweep away the entire steam equipment as surely as that equipment displaced the post chaise and its relays in the last century. Low fares will therefore be the result of this establishment of electric traction systems; first, between near-by points, and then between more distant centers, until the entire country is covered with a co-ordinated network,

The consideration of these facts may not make it dignified to carry conclusions further than the immediate necessities of the hour indicate, but at least the inexorable logic of events will be the means of shaping the future, in a broad and national sense, as it has been the means of transforming local conditions in a variety of isolated instances in a more constricted sense. In other words, it has been clearly shown by the rapid settlement of suburban territory, that the trolley car has exercised an almost magic influence in creating around the core of the older settlement a band of contiguous, well-established and prosperous homes and industries. The further the trolley extends, just as much further the streets extend. The most powerful means therefore, potentially and actually, of extending the populated centers of a given community, are electric traction. What is true of a well expanded center of population is also true of other units of the same character. And what is a nation but a series of cities and towns? If between them all the great highways of traffic, commerce and transportation, are energized by electricity, a species of regeneration will transpire. Sluggishly developing towns will take on new life, and the influx and reflux of people under the influence of lower rates for transportation will establish civic stability and enterprise, where only flimsy coherence before existed.

Electric traction and lower transportation rates will stamp this epoch as unique by emphasizing such typical features in our national history.

* * *

Rotaries in Power Schemes.

Power schemes have been readily furthered by the advantages derived from the application of rotaries to convert alternating into direct current and the reverse. But the developments in this direction have not been limited to the mere expansion of power propositions either in the abstract or the concrete. They have been of the highest value in drawing attention to the fact that their introduction has meant a new elasticity in the application of electricity in specific directions. This elasticity may be more aptly defined as an ease in sending considerable quantities of power in various directions over given distances for use in particular cases, with an average uniformity of efficiency that clearly betokens the highest standard of transmission.

The beneficial consequences arising from this method have been found in the spread of tunnels, electric lights and street railways. The tunnels projected could not succeed if the air were fouled to any extent, as it would by the use of steam locomotives. Electricity in this case, as in that of the others, when obtained from a series of sub-stations, readily solves the problem of widening the circle of electrical effectiveness. It may be said, without reservation, that the abundant success of electrical enterprises is pivoted upon the present established success of rotary coverters and power house equipments. Whatever the use of large or small quantities of power may mean, it at least means that any increase in the consumption, is a certification of an addition to the quantity of power, and, therefore, of the rotaries converting it for transmission and distribution.

* * *

Diversity of Lighting in New York.

The specialist in lighting must feel fully satisfied in viewing New York that whatever is marked down in the category of lighting possibilities is employed in the effort to produce illumination in the store windows of our main thoroughfares.

The diversity of the lighting systems in vogue is perhaps to be included as one of the striking features of this great cosmopolis. There is extant, particularly in the business streets, a "light hunger," if it may be so called. Gas, Welsbach, Nernst, arc, incandescent, vacuum tube and mercury vapor lamps are in constant use throughout the city. The streets are now lit by Welsbachs, with brilliant arcs at consecutive corners. Broadway is a curious scene, a medley of lights. Predominating over all is the arc, incandescent and Nernst, particularly the former two. At isolated intervals the brilliant greenish glare of the mercury vapor, or the dawn-like glow of the vacuum tube, creates a contrast on the greater background of yellowish glitter. From a technical standpoint these phrases of illuminatian are significant, not only as actual steps in practical lighting, but as a means of judging of the degree to which each system has been perfected. Economy as thus exemplified is to be best regarded as a belief that the best light is the cheapest. Not, however, the apparatus costing too much to install, or even the cheapest bright light, which the greenish glare of the mercury vapor amply discloses, but the most suitable to store and window illumination on the one hand, and street and corner lighting on the other. It is a good thing that the attitude preserved toward innovations is one of respectful attention, and not of discreditable criticism. This is particularly true at present, for the reason, as already stated, that the demand for bright and cheaply installed light, is always on the increase, not the decrease. In all probability, the city of New York is not only the most brightly lit city in the world, but the city lit by the greatest variety of systems of lighting as well.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

A new development in electric welding is the automatic production of continuous rolls of wire fencing, says the "Iron Age." A number of galvanized wires are fed from reels arranged vertically and parallel to each other, and from another reel placed transversely to these are cut off lengths of wire, which are fed horizontally across the vertical wires. Where the horizontal and vertical wires intersect, these are welded together by means of small transformers. The welded section then moves forward a predetermined distance, and the operation is repeated.

◆

It is not unlikely, says the "Electrical Engineer," London, that, with Russia's attention being first directed to affairs in the Far East and then towards the pacification of her internal disorders, many of her industries must be adversely affected by reason of neglect and unsettled conditions, and of these, the fate of the platinum industry in Russia is viewed with most concern by electricians.

◆

Advices from abroad state that the Swiss Government has decided to open the Simplon tunnel at once with electric traction. The length of the line through the tunnel is approximately 12½ miles, which makes it the longest tunnel line in the world. Five electric locomotives will at first be used.

◆

There is considerable talk these days regarding the adoption of the metric system instead of the system of weights and measures now generally in use in this country. Unless the metric system is adopted throughout every line of business, it will lead to much confusion and unnecessary figuring.

◆

The Cunard liner Carmania, which in place of reciprocating engines, is equipped with the most powerful installation of model turbines yet conceived, has just arrived in this port. A description of the electrical features of this ocean greyhound will shortly appear in the columns of ELECTRICITY.

◆

The Bell Company's new stock issue of $150,000,000, which was mentioned in last week's ELECTRICITY, is explained in this way: "The company has sufficient cash in its treasury to meet its probable requirements until well into the year 1906, but it is desired that the requisite authority to issue bonds should be conferred upon the directors that they may be in a position to take advantage of any favorable opportunity that may arise, and to act promptly upon any financial plan that may seem advantageous."

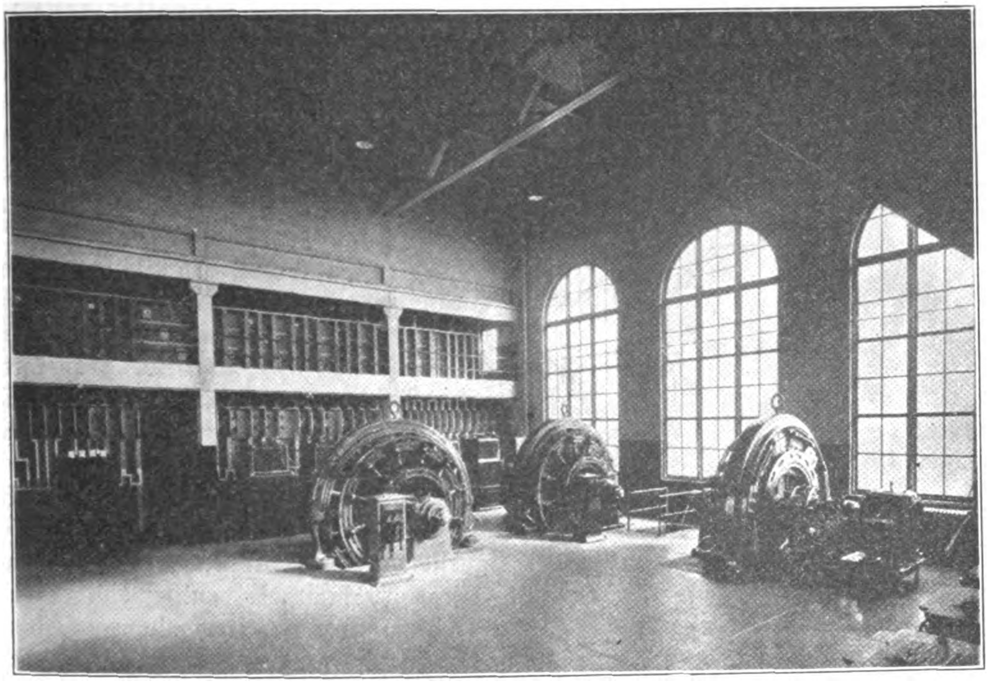
◆

Probably many are aware that the River Rhone in Switzerland on leaving the canton of Geneva, near Bellegarde, disappears in a subterranean gulf, and does not re-appear on the surface of the earth for some considerable distance. This geological phenomenon will soon be a thing of the past, as three proposals are now being studied for the construction of a barrage and of a canal for the reception of the waters of the river. The projects in question comprise the construction of a barrage of 25 meters in length, two parallel tunnels of 4,600 meters, two generating stations, and a waterfall of 58 meters with a total power of 155,000 hp., capable of being supplied for three hundred days in the year. The total cost is estimated at $5,000.000.

THE ELECTRIFICATION OF THE LONG ISLAND RAILROAD.

BY A. FREDERICK COLLINS.

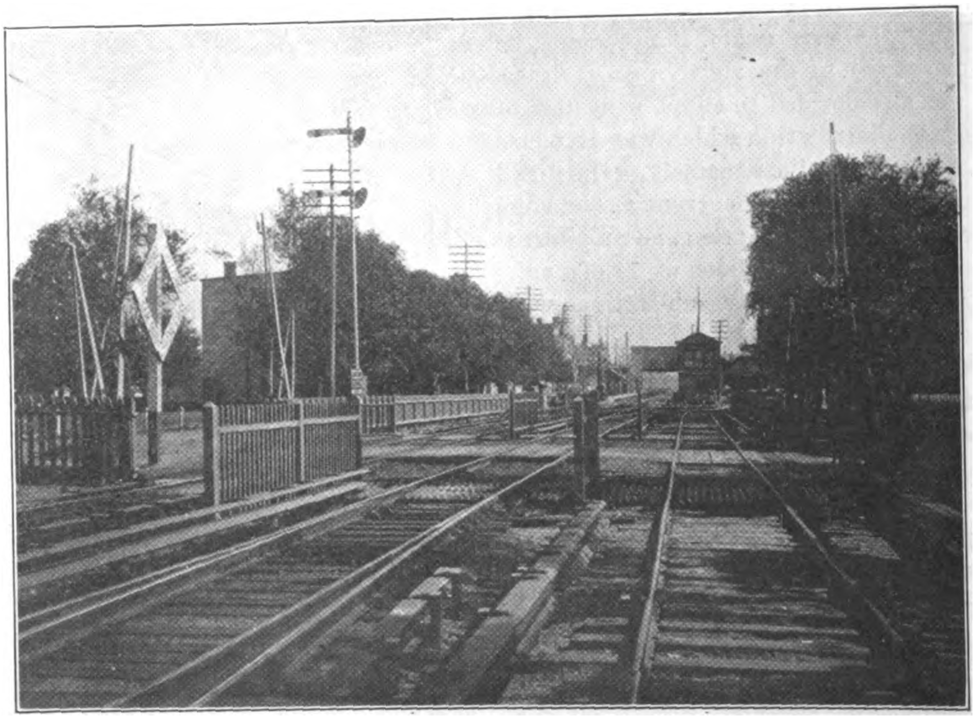
The Western Division of the Long Island Railroad consists of numerous lines within the limits of the City of New York, and while the main terminus of the road is in Long Island City, opposite 34th street in Manhattan, the road has another very important terminus at the intersection of Atlantic and Flatbush avenues, Brooklyn. The line from Jamaica to East New York originally traversed an open farming country, but the enormous growth of the outlying districts of Brooklyn resulted in building up almost solidly this section and beyond to a distance of a little over five miles.



Interior View of East New York Sub-station, Showing High Tension Switching Galleries.

In an agreement with the City of New York the railway company undertook to remove its tracks from the surface of Atlantic avenue, and to operate its passenger trains by a motive force not requiring combustion locomotives. This requirement obviously pointed to the utilization of electricity and to devise a satisfactory train service in this short section has resulted in the most extensive system of electrification yet put into operation on any steam railway in the world.

The Flatbush Terminal, as it is known, is in the heart of the Borough of Brooklyn and connects at that point with the Brooklyn Rapid Transit elevated lines leading to the Brooklyn Bridge and to the Broadway Ferry, and it will also connect with the subway tunnels now in process of construction by the Interborough Rapid Transit Company from the Battery, Manhattan, under the East River, and thence at Flatbush and Atlantic avenues. It will be seen that upon the completion of the subway tunnel passengers arriving at the Flatbush Avenue Terminal from various points on Long Island will have a short and direct route to the lower business section of Manhattan Island by either the subway or by elevated over the Brooklyn Bridge. Besides these facilities, direct connection will be established by the elevated lines over the new Williamsburg Bridge. The regular service at the Atlantic avenue station consists of not only suburban trains carrying passengers from the south and north shores of the island, but also a heavy local business from Flatbush avenue out to Jamaica and a very heavy excursion business to Rockaway Beach, and three different race tracks, located at Aqueduct, Metropolitan and Belmont Parks respectively. The nature of this varied traffic complicates the train service to such an extent that it was obviously impossible to adopt an electrification plan which contemplated electric haulage over a portion of the route and steam haulage over the remaining part, inasmuch as the traffic of passengers to the principal points would result in endless confusion and delay.

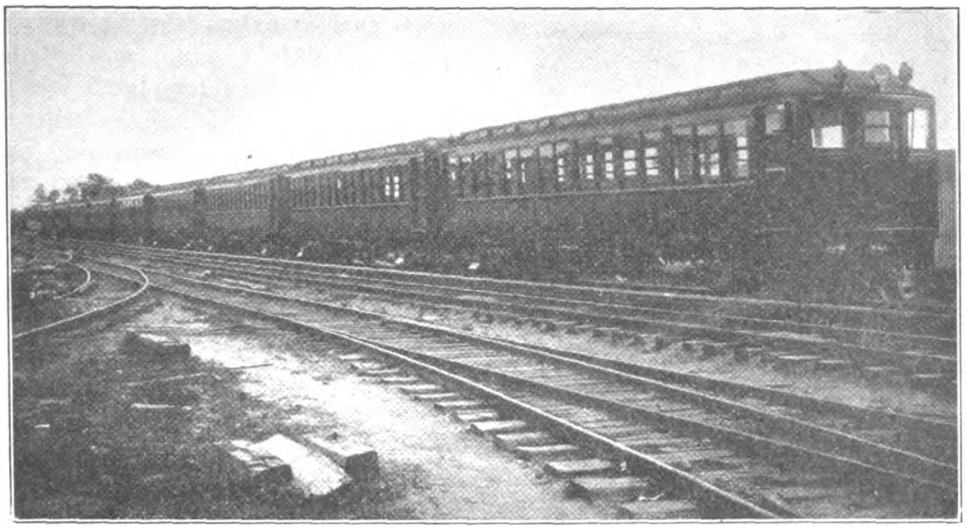


Third Rail Layout at Highway Crossing Near Woodhaven Junction.

Consequently it was decided, in spite of the fact that immediate returns on the heavy financial outlay could not be expected, to electrify all the suburban and excursion lines leading out of the Flatbush Avenue Terminal. This practically resulted in the electrification of the entire road south of Atlantic avenue and the main line out to Queens, and as far east on the Montauk Division as Valley Stream. It was not deemed necessary to electrify the line north of this, as no through traffic from Flatbush avenue to the terminal in Long Island City at present exists.

The diverse character of the train service and its very fluctuating loads at different seasons of the year, due to the excursion business, formed an extremely unfavorable condition for economical electric traction, for the reason that the load factor on any of the fixed portions of the complete system, as the power house and transmission lines, would of necessity be a low one throughout the year, except at certain seasons during the summer months.

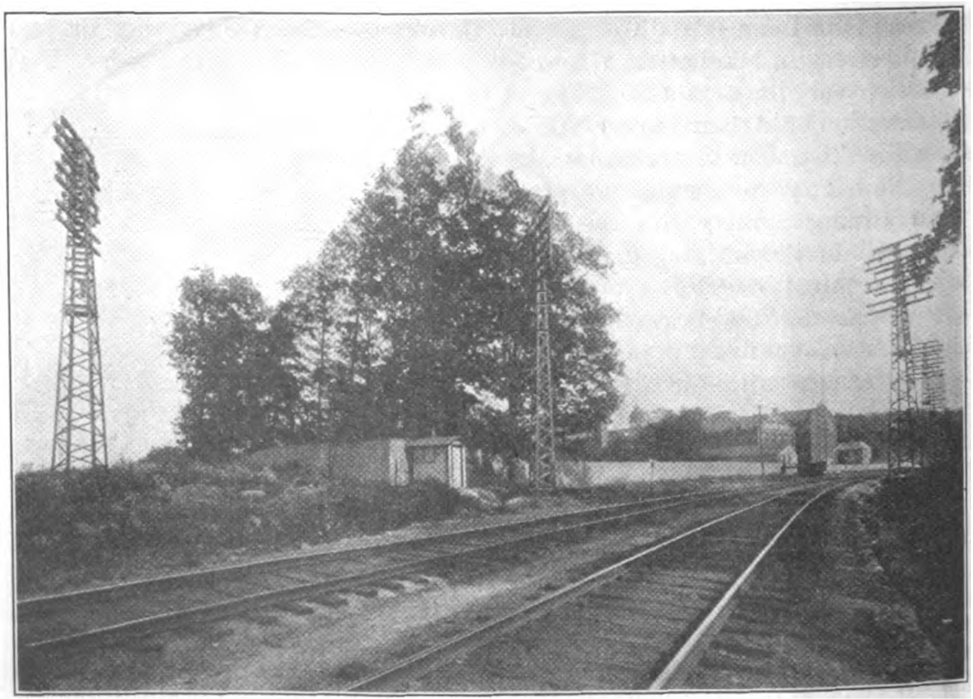
Notwithstanding these untoward conditions, which meant an enormously heavy initial expenditure, the management of the road determined to provide a complete electric service at the outset, having faith that the improved facilities afforded would result in the growth of the territory adjacent to their line and in the end afford them a fair return on their investment. In deciding upon a system the possibilities of connecting with the lines of neighboring companies had to be considered, and the operation of the rolling equipment over elevated lines, in subways, on the surface and also in the tunnels, had to be unified and harmonized so that the cars could, if necessary, be run over any of the above named lines. It was also decided to adopt a system of electric distribution which was standard on the adjacent lines, namely, a third-rail contact and a direct current at 600 volts for the propulsion current and an alternating current transmission at 11,000 volts for conversion at the sub-stations were provided.



View of Train of Steet Cars.

This high voltage current will be generated at the large power house, now nearly completed at Long Island City. This power house will be eventually one of the largest in the world, and has the distinction of being entirely equipped with steam turbines. At the present time three Westinghouse-Parsons turbines of 5,500 kilowatts capacity are installed, and the engine room provides facilities for three similar units. The three-phase currents thus generated are carried in conduits through the built up portion of Long Island City as far as the railroad yards. From this point the cables are brought overhead and carried on a specially designed lattice steel pole mounted on concrete foundations.

The sub-stations have been located at junction points wherever possible, such points being more practicable, for it is at these places the heavy loads occur. The locations also make it possible and convenient for the arrangement of transfer switches for the high-tension circuit. There are five sub-stations, the one at Woodhaven Junction being the largest; it is now provided with an equipment comprising three 1,500 kilowatt rotary converters and nine static transformers of 550 kilowatt capacity. Ultimately this station will be doubled in capacity. The Grand avenue sub-station has an equipment of three 1,000 kilowatt rotary converters and nine static transformers of 375 kilowatt capacity.



Steel Poles at Crossing.

All of these sub-stations, it may be stated, have foundations of sufficient size to accommodate much larger machines, the idea being that as soon as the present sub-stations reach their maximum capacity the electrically equipped railway will have extended far enough to warrant the building of more sub-stations at greater distances on Long Island. The 1,000 kilowatt converters will then be moved from their present stations to those further out, and in their places converters of 1,500 kilowatt capacity will be installed. The Rockaway Junction sub-station is provided at present with two 1,000 kilowatt rotary converters, and six static transformers of 375 kilowatt capacity.

The East New York sub-station has an equipment of three 1,000 kilowatt rotary converters, and nine 375 kilowatt transformers, and the sub-station at Hammels has two 1,000 kilowatt rotary converters and six 375 kilowatt transformers. This sub-station has also, in addition, a storage battery of 2,000 kilowatt hours capacity, making it the largest storage battery in the world in use for electric railway work. Its installation was deemed expedient, owing to the fact that the Hammels sub-station is the furthest from the power house and the unusual exposure of the transmission line, which is carried over Jamaica Bay for four miles. Again, the load at Hammels is very light during the winter, and the very large battery capacity makes it practicable to shut down the rotary equipment for much of the time during the winter months.

The appearance externally of the sub-stations is very much alike, all being built of brick and steel and fireproof construction throughout. They also conform closely in their interior arrangements, the rotaries and transformers being set up on the main floor, while the main switchboard is placed in a gallery on one side of the building from which the operators have an uninterrupted view of all the machinery under their control. A novel feature in connection with the sub-station is that all of them are provided with means for augmenting their capacity to the extent of 1,000 kilowatts, should such an emergency arise, through the use of portable sub-stations. These consist of steel cars, each carrying 1,000 kilowatt rotary converters and three static transformers. Two of these portable sub-stations have already been built and are in use. While the use of portable sub-stations is not altogether new, yet it is interesting to know that they are being used on a larger scale in this installation than has ever before been attempted. One reason for their extensive use is found in the fact that no feeders are used for supplying the third rail, the high conductivity of these permitting feeders to be dispensed with for all ordinary conditions of traffic. The direct current at a pressure of 600 volts is led directly to the third rail from the different sub-stations and is carried in this way to considerable distances. Great care has been taken in the installation of the third rail so that the safety of pedestrians may be assured, and much ingenuity and money has been spent to attain this result.

The third rail is laid 27 inches from the gauge line of the tracks, the standard distance adopted by the various roads, and it is covered throughout its length by a wooden sheathing held in place by brackets attached to the rail. Wherever the rail is led in part at stations a special side sheathing is attached to both sides, making it practically impossible for pedestrians to come in contact with it. At either side of a grade crossing the third rail terminates in a broad sloping shoe, and this is considerably within the line of protecting fences which inclose the entire right of way.

The trains at present are made up entirely of steel motor cars, of which nearly 200 have been equipped, but eventually the trains will comprise both motor and trail cars in the ratio of three to two; that is, a five car train will consist of three motor cars and two trail cars, the motor cars being 1, 3 and 5 respectively. All the cars will be furnished with the Westinghouse pneumatic multiple unit system of control and each motor car has two motors of 200 hp. each, both of which are carried on the same trucks that is, each motor car has a motor truck at one end carrying two motors, one geared to each axle, while the truck at the other end of the car is a "trailer," and carries no motor.

These cars are quite similar in design to the steel cars used in the Manhattan subway, and are constructed throughout of steel and finished in aluminum. Each motor car weighs 83,000 pounds, and is capable of maintaining a speed of 55 miles per hour. A noticeable feature in their operation is that there are no jars nor jerks experienced when they are attaining their maximum speed under short headway, and the trains are brought to a stop in the same even manner.

When it was decided three years ago to electrify the Long Island Railroad, Westinghouse, Church, Kerr & Co., were engaged to act as engineers and constructors, the entire work being under the direction of Mr. George Gibbs, who is chief engineer of electric traction, while the general features of the work were under the supervision of the electrical committee of the road, composed of various officials. The construction work was under the supervision of Mr. George B. Caldwell, who acted as superintendent of that department.

Work was begun on the power house September 15, 1903, and the first turbine was run on January 6, 1905; the sub-stations were begun May 4, 1904, and completed July 7, 1905; the transmission system was started November 30, 1904, and finished May 27, 1905, while work on the third rail and bonding the tracks was begun October 6, 1904, and finished August 31, 1905, the whole system then being articulated and put into operation July 26, 1905.

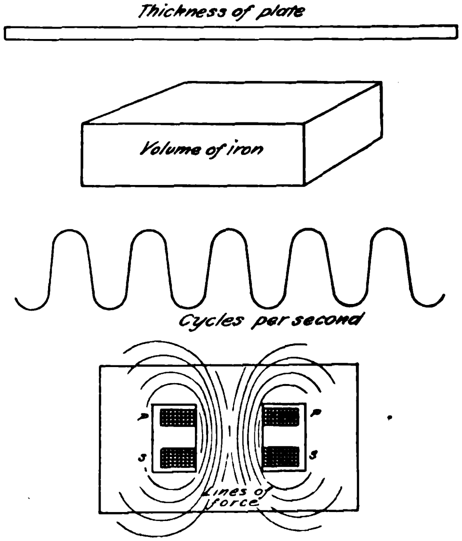
LIGHT, HEAT AND POWER PRINCIPLES.—XII.

BY NEWTON HARRISON, E. E.

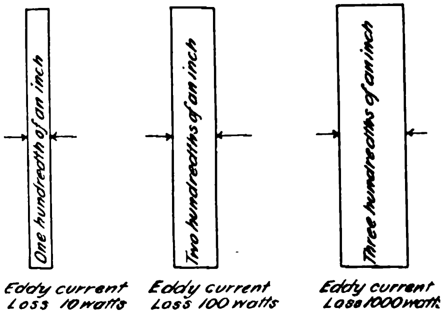
Eddy Current Losses.—In all cases where sheet iron is alternately magnetized and demagnetized the effect of the lines of force is to create within the iron an EMF. which causes minute currents to flow in it. These currents are sufficiently minute to be of little consequence individually, but collectively they are of such importance that unless checked a considerable percentage of the available energy will be uselessly dissipated. The method employed, namely, that of subdividing the iron, is successful if means are taken to insulate the sheets from each other. The thinner the iron sheets the less the waste of energy through the generation of eddy currents, and the thicker the sheets the greater the waste of power. Practice, however, shows that limitations of thickness are best found in a certain average, such as is commonly discovered in ordinary Swedish sheet-iron or its near equivalent of American manufature. The formula f eddy current losses takes into consideration the thickness of the iron, the volume of the iron, the cycles per second and the degree of magnetization, as shown in the following symbolic arrangement of these quantities:

$$W = 1.645 \times V \times f^2 \times t^2 \times B^2 \times 10^{-11},$$

where W = the watts wasted, 1.645 = a constant whose value is variable, though approximately as stated, V = the volume of iron in cubic centimeters, f^2 = the square of the cycles of magnetization per second to which the iron is exposed, t^2 = the thickness of the laminations in centimeters squared of the iron composing the transformer core, and B = the lines of force per square centimeter in the core. As may be noted by an examination of the formula, the watts wasted in the iron are directly proportional to the volume, indicating that the greater the weight of the core the greater will be the watts wasted through eddy currents. An increase in the frequency affects the iron somewhat differently however; doubling this means four times the effect developed before, tripling it nine times the original effect, etc., as noted by f^2.



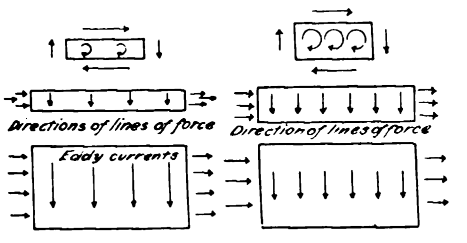
The elements limiting the eddy current losses.


One hundredth of an inch
Two hundredths of an inch
Three hundredths of an inch
Eddy current Loss 10 watts
Eddy current Loss 100 watts
Eddy current Loss 1000 watts

Effect of doubling and tripling the thickness of core plates of a transformer.

Varying the Thickness of the Iron.—

Increasing the thickness of the iron is evidently the means by which eddy currents are rapidly multiplied. The reason for this is the reduction of resistance and the increased EMF. developed in the iron through its greater effectiveness as an inductor. For instance, if an iron plate .1 of an inch thick generates EMF. in a given field of magnetism, and the thickness is increased to .2, then not only in this case is the EMF. doubled, but the resistance of the plate is halved, thus raising the current to four times its original value. In other words, the most important practical elements in eddy current losses are the thickness, the lines of force and the frequency. The formula for EMF. which considers the relationship between the conductors, lines of force and speed in an armature is applicable here in showing the nature of the increase in waste energy in the iron plates through either an increase in the lines of force per square centimeter, the frequency per second of the current or the greater or less thickness of the iron plates. To take a specific case, suppose it is desirable to know how many watts are being wasted in 1,000 cubic centimeters of iron, composed of plates of .1 of a centimeter thick, the iron exposed to a series of 100 cycles per second at a magnetization of 5,000 lines of force per square centimeter, then the following data appears: $t = .1$, therefore $t^2 = .01$; $f = 100$, therefore f^2 10,000; $B = 5,000$ therefore B^2 25,000,000, and $V = 1,000$ cubic centimeters. Applying these items to the formula give the following: Watts wasted in eddy currents: $W = 1.645 \times .01 \times 10,000 \times 25,000,000 \times 1,000 \times 10^{-11}$ is equal to $1.645 \times .01 \times 10^4 \times 25 \times 10^6 \times 10^3 \times 10^{11} = .41125 + 10^{13} \times 10^{-11} = 41.125$ watts.

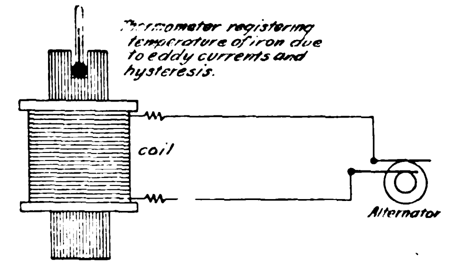


Eddy currents developed through thickness of the iron.

More eddy currents through greater thickness of the iron.

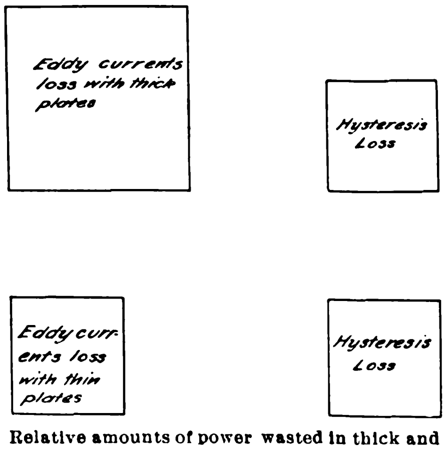
EFFECT OF THICKNESS OF IRON ON EDDY CURRENTS.

The feature that plays an important part in calculations of waste power in the iron is that of the rise in temperature. This increase in heat is due to two ineradicable causes: First, the heat of transformer coils, both primary and secondary, and second, the hysteresis and eddy currents of the iron itself. The consequence of this heat is the increased resistance of the iron plates, and the reduced waste of energy due to the eddy currents. On the other hand, the rise in temperature of the iron is a cause for a reduction in permeability, which if permitted to reach too far will not only affect the insulation and magnetizability, but absolutely limit the capacity of the transformer. Cooling methods are therefore advisable for purposes which affect the entire operation as well as any one particular part. The calculation shows that for commercial thicknesses of wrought iron or mild steel, as is commonly used in transformer construction, the eddy currents are comparatively a negligible quantity. Where only 40 or more watts are consumed from this cause by eddy currents at the magnetization given, namely, 5,000 lines of force per square centimeter, this induction means a hysteretic waste of $1,658 + 1,000 + 100 \times 10^{-7}$ or 16.58 watts. But the value of 41 watts lost by eddy currents is based upon a thickness of .1 centimeter for the iron, as compared with the 16.58 watts lost through hysteresis. If the iron is reduced in thickness the eddy current loss will diminish greatly. For instance, if the iron is taken as equal to .05 cm. instead of .1 cm. then the calculation gives a value of $1.645 \times .0025 \times 10^4 \times 25 \times 10^6 \times 10^3 \times 10^{-11} = 10.28$ watts, or about one-quarter of the first value obtained.


Thermometer registering temperature of iron due to eddy currents and hysteresis.
coil
Alternator

Temperature of iron increased through eddy currents and hysteresis.

As a centimeter is about .4 of an inch, .05 centimeter is equal to .02 of an inch or $\frac{1}{50}$. The idea presented here is to show that the waste of power due to eddy currents will become very great unless the correct thickness of iron is adopted in its construction. In fact the figures show that doubling or tripling the thickness of the iron means four or nine times the waste of power. Also that reducing the thickness to one-half or one-quarter means reducing the eddy current loss to one-quarter or one-sixteenth of its former value.

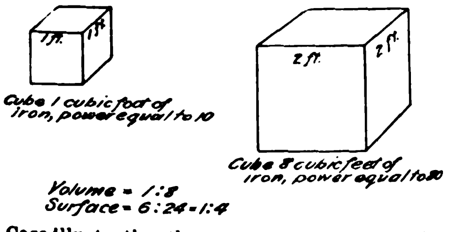

Eddy currents loss with thick plates
Hysteresis Loss
Eddy currents loss with thin plates
Hysteresis Loss

Relative amounts of power wasted in thick and thin plates by eddy currents and hysteresis.

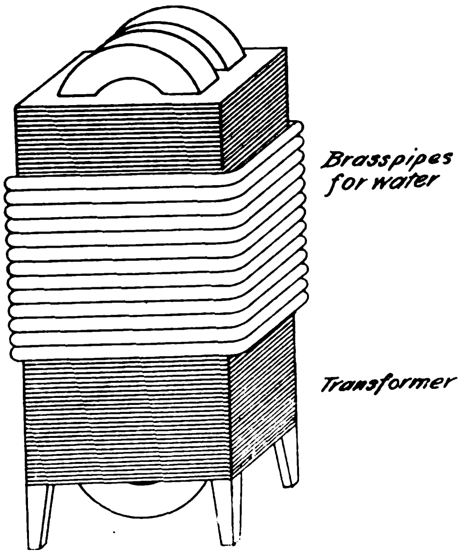
Rating of Transformers as to Temperature.—The American Institute of Electrical Engineers has passed certain rules and limitations regarding transformers, for the perpetuation of good service and a practical maximum working temperature in its parts as follows: "In transformers for continuous service, a rise of temperature of copper not exceeding 50 degs. C. (90 + 32 = 122 degs. Fahr.) as measured by change of electrical resistance of primary and secondary coils; and a rise of temperature of other parts not exceeding 40 degs. C. (72 + 32 = 104 degs. Fahr.) as measured by a thermometer laid against the part, the core, for example, under normal conditions as to ventilation. In the case of transformers intended for intermittent service, or not operating continuously at full load, but continuously in circuit, as in the ordinary case of lighting transformers, the temperature elevations above the surrounding air temperature shall not exceed 50 degs. C. (122 degs. Fahr.) as measured by resistance in electric circuits, and 40 degs. C. (104 degs. Fahr.) as measured by the thermometer in other parts after the period corresponding to the term of full load. In this instance, the test load should not be applied until the transformer has been in circuit for a sufficient time to attain the temperature elevation due to core loss. With transformers for commercial lighting, the duration of the full load test may be taken as three hours, unless otherwise specified." A further suggestion made by this eminent body, is that transformers should be overloaded 25 per cent. for a period of two hours, during which time the increase in temperature must not exceed 27 degs. Fahr. over the ordinary full load test, when they are to be rated for an overload of this value. If the lighting or power circuits cause a greater overload than this the temperature requirements must be strictly complied with, or the transformer will overheat, burn out, and thus become inoperative.

Effect on Hysteresis and Eddy Currents During Overload.—The effects of an overload on a transformer are discovered in the additional heating of the coils composing the primary and the secondary and possibly in the iron The heating of the iron increases, only because the hys teresis increases with any augmentation of the lines of force, or as indicated by the formula: Watts wasted = $nB^{1.6}$. The eddy current loss will also increase if the lines of force increase, because this is proportional to $f^2 B^2$ in the formula, these being the variable factors. An overload does not increase the frequency f, but if it increases the lines of force per square centimeter B, then $f^2 B^2$ is greater than before only because B^2 is greater. If the magnetizing forces of the primary and secondary coils equalize throughout the process of underload, normal load and overload, the iron core will not carry any more magnetism than a certain amount throughout these changes. As a result of such conditions, neither the hysteresis or eddy current loss will increase; but an increase of lines of force would readily increase both.

Effects of Increased Size in Transformers.—A relationship that must be understood in comparing the losses of transformers of different sizes, is one which affects their manufacture to a remarkable degree. It is that which explains the increase in heat with an increase in size as follows: A given transformer taken as a standard, which has a certain loss in watts through causes already enumerated, and a certain radiating surface, will in comparison with a transformer twice the size show that the larger one has eight times the volume of metal but only four times the radiating surface. In other words, the internal losses are eight times as great, while the power to radiate the heat is not more than four times that of the smaller size. The consequences of this state of affairs would obviously be a heavy rise in temperature, unless provision is made in one of two ways: First, to make the transformer very much larger, in fact so large that the radiating surface per watt wasted remains constant. Second, to supply some means of dissipating the heat rapidly enough from the transformer to keep it at a safely low temperature. Various methods are employed in central stations and large power plants among which may be noted the following: 1st, transformers designed in such a manner, that their natural radiating surface is greatly increased by means of extensions and ribs, an expensive method of proceeding; 2d, transformers cooled by placing the transformer in an oil bath, the oil being in communication with an outer shell to which its heat is communicated rapidly; 3d, transformers supplied with an air blast connected to blowers, which use up energy in keeping the transformers down to the right temperature; 4th, transformers cooled by means of a water supply system, which, being pumped around means a loss of power in this direction; 5th, combination systems consisting of means representing more than one of the above items in the cooling process.


1 ft.
1 ft.
Cube 1 cubic foot of iron, power equal to 10
2 ft.
2 ft.
Cube 8 cubic feet of iron, power equal to 80
Volume = 1:8
Surface = 6:24 = 1:4

Case illustrating the transformer iron when increased for extra capacity, but showing a slower increase in radiating surface.



Transformer with brass pipe system for circulating water when entire device rests in an oil bath.

Self-Cooling Transformers.—By constructing a transformer of such a size that all its radiating surfaces are increased sufficiently to express the ratio of two or three square inches per watt, would mean that a transformer whose core loss is 100 watts, and whose coil loss is 1,000 watts, would need at least 2,000 square inches radiating surface for its coils, and at least 200 square inches for its iron surface. A self-cooling transformer is therefore best understood as one whose iron mass is about twice as great as it actually need be in order to keep the iron cool; and whose windings are relatively to this iron mass too small. The expense pertaining to a transformer built on these lines is too great to be justifiable. It is equivalent to a case where it is necessary to make a motor or dynamo twice as large as is actually required for the power in order to get sufficient cooling surface.

Advantages and Disadvantages of Oil.—The advantages of oil in transformer service are sufficiently great to make this application an idea of the highest value. In the first place, oil is an insulating fluid which preserves the integrity of the transformer without electrical risk. But it also adds an element of fire risk which is its one great objection unless absolute precautions are taken to eliminate it. A spark flashing across cannot cause the injury to insulation with oil in use that would otherwise occur, but the comparative rapidity with which oil absorbs heat presents great advantages in holding the temperature down. Its use means a slow rise of temperature, an intact insulation, but a fire risk that may be regarded as dangerous. The appearance of sparks or disruptive discharges beneath the surface of the oil mean very little in comparison with the same discharges above or near the surface. When the inflammable parts catch fire with air present they instantly serve as a huge wick and destroy the apparatus. Care in installation is a reasonably safe guarantee in such instances.

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TEMPERATURE AND THERMAL RADIATION.

Before the London Physical Society Mr. James Swinburne recently read a paper on "The Question of Temperature and Efficiency of Thermal Radiation." It has long been known that various surfaces have different emissivities, and it is generally held that at a given temperature some bodies radiate a larger percentage of their total radiation in the form of light. This view is largely based on some experiments by Evans and Bottomley. Evans' experiments really show that if two filaments A and B of the same area but of low and high emissivities respectively are run to give the same light, the filament A of lower emissivity will give a higher efficiency, and it will give a still higher efficiency if run so as to use the same power as B. This is a natural consequence of the different emissivities, and does not at all show that A gives a higher efficiency at the same temperature as B. Professor Bottomley's experiments are criticised on the ground that he used no photometer, and his reasoning attacked on the ground that he makes the same slip as Evans in confusing difference of emissivity with difference of efficiency at the same temperature. It is urged that a body A at the same temperature as B cannot give out radiation corresponding to a higher temperature of B; for if it could, and A and B were inclosed in a perfectly reflecting space, A would heat B to a higher temperature than A. It may be said that A can have a higher efficiency than B, not by giving out rays corresponding to B at a higher temperatere but by omitting to give some of the longer radiations that B gives. If this were true, a hot body might be surrounded by a thin case of A lined inside with a substance which only emitted and absorbed long waves. The case would then take in long and give out short waves, though colder than the source. High efficiency or selective emissivity are always sought in polished, grey, or white surfaces like flashed filaments, platinum and other metal wires and rare earths. If there were such a thing, it should be found not in white but in black bodies, as a body which is a specially good radiator of light when hot should be black when cold. Lummer's curves of the distribution of energy for a "black body" and polished platinum are compared, and show somewhat higher efficiency for platinum; but the comparison is difficult. The behavior of flashed lamps and incandescent gas-mantles is explained by the difference of emissivity, without any need for selective emissivities.

The secretary read a letter from Dr. J. T. Bottomley, in which he stated that the author's paper seemed to be to a large extent an attack on his work on radiation. He could not see that Mr. Swinburne had made a single experiment in support of his proposition that "In the case of pure temperature-radiation, the light efficiency is a function of the surface-temperature only." No amount of discussion such as the author asked for could do anything to prove or disprove this proposition. He failed to see that the author had worked out any logical proof of the proposition. The author had assumed that he (Dr. Bottomley) was incapable of matching the light-giving properties of two platinum strips placed side by side and properly arranged for this sort of comparison. The matching is exactly the same in principle as in shadow photometry, and in all the cases cited in the paper to which Mr. Swinburne takes exception, Dr. Bottomley's determinations agreed with those of his assistant, Mr. Evans.

Dr. J. A. Harker expressed his interest in the paper, and said that the question of radiation was of practical importance in the measurement of high temperatures by electrical resistance methods. He asked if two platinum thermometers, one bright and the other blackened, but identical in other respects, were transferred from an ice-bath into a sulphur-bath, would the final temperatures of the two thermometers be the same, and also would the thermometers approach their final temperatures at the same rate?

Prof. H. L. Callendar, referring to Dr. Harker's questions, stated that if the sulphur-bath was in an isothermal inclosure, the two wires would reach the same ultimate temperature although the blackened one would reach it quicker. The difference, however, would be small. With fine wires the loss of heat by conduction through the gas is more important than the radiation loss. The loss by radiation is proportional to the surface but the loss by conduction is not, and it therefore becomes relatively more and more important with the fineness of the wire. With regard to the action of incandescent mantles, he thought the author's theory was reasonable and satisfactory.

Mr. Maurice Solomon said he did not agree with Mr. Swinburne's contention that in the case of solids there was no such thing as selective emissivity, but that all bodies at the same temperature radiated light of the same efficiency. Selective emissivity existed in the case of incandescent vapors, and if it was consistent with the laws of thermodynamics in such a case, it could not be inconsistent in the case of an incandescent solid. With reference to the incandescent mantle, the explanation put forward by the author did not seem satisfactory. It was difficult to believe that the very small differences in color between a thoria, a thoria-ceria, and a ceria mantle could account for the enormous differences in their candle-powers.

Prof. W. E. Ayrton referred to experiments which he had carried out which tended to show that the temperature of a Bunsen flame was lowered by an incandescent mantle. He had also found that small pieces of mantle heated in a platinum boat to various temperatures just below the melting-point of platinum never looked brighter than the platinum. If, however, a small hole was made in the bottom of the boat and coal-gas passed in, the mantle immediately became brilliant.

Mr. Swinburne, replying to Dr. Bottomley, said that his main argument was that he had not made experiments. In the investigation of a question such as that considered in the paper, it was possible to prove much by means of experiment, but it was also possible to attack the problem by thermodynamic reasoning. He expressed his interest in the fact that Prof. Callendar had referred to his views as reasonable.

Telegraph Lines in Alaska.

A party of 30 men is constructing a military telegraph line between Rampart and Fort Gibbon, Alaska. The new construction is on high ground, will do away with a loop through the low, marshy, and dangerous ground of the Lower Tanana, and will obviate difficulties experienced in maintaining communication between the two points. A military telegraph line between Valdes and Fort Egbert, a distance of 422 miles, was interrupted during the past month for only five hours. This is considered a remarkable record, in view of the character of the country traversed. The United States cable ship Burnside is now at Tacoma, preparing to lay a short cable between Forts Lawton and Ward.

ELECTRIC MOTORS IN THE MACHINE SHOP.

BY W. H. WAKEMAN.

ARTICLE II.—(*Concluded.*)

Fig. 6 illustrates a radial drill with a tilting table, driven by a 5 horse power motor that seems to be an inseparable part of the machine because it fits so nicely into its place on top of the post. This motor is of the open type, as there is no good reason why this kind should not be used in an ordinary machine shop.

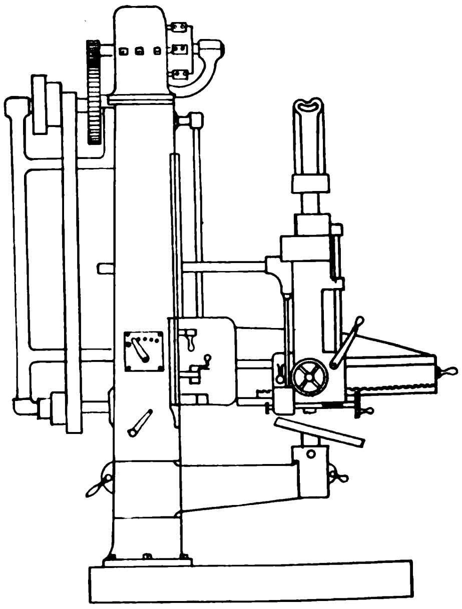

FIG. 6.

Drills of different sizes may be run at varying speeds according to size of drill and kind of material worked, therefore a variable speed motor gives satisfaction because its speed can be changed so easily.

Fig. 7 resembles Fig. 6, but it is of the portable type of radial drill, with a vertical motor at the top. The round post sets into place to hold it firmly upright, where it may be used on heavy work located in that vicinity. When this is finished a chain is attached to the arm near the post, a hook suspended from an electric crane is hooked into it, and the whole machine is carried away to another place where wires are attached and the motor set in motion in much less time than it would require to move one of the pieces to be drilled.

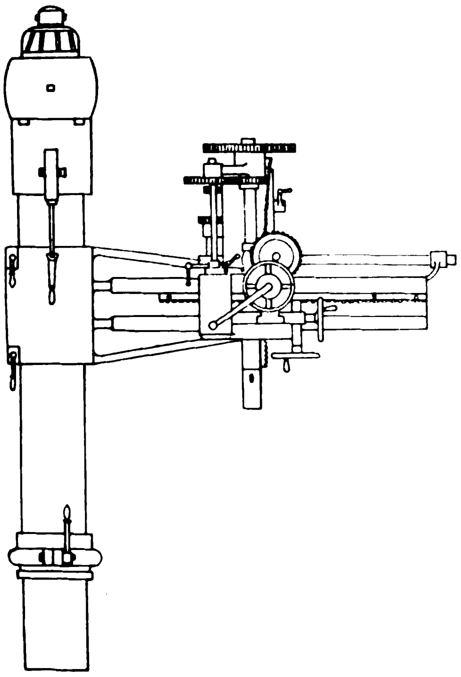

FIG. 7

Fig. 8 is a turret lathe driven by electric transmission of power. It has twelve speeds forward and the same number backward, enabling the operator to use it to the best possible advantage.

Fig. 9 is an extension base shaper, driven by a variable speed motor, which may be run from 300 to 1,600 revolutions per minute. This kind of a machine requires a very solid foundation that will not tremble when much stress is thrown upon it by rapid reversals of the table.

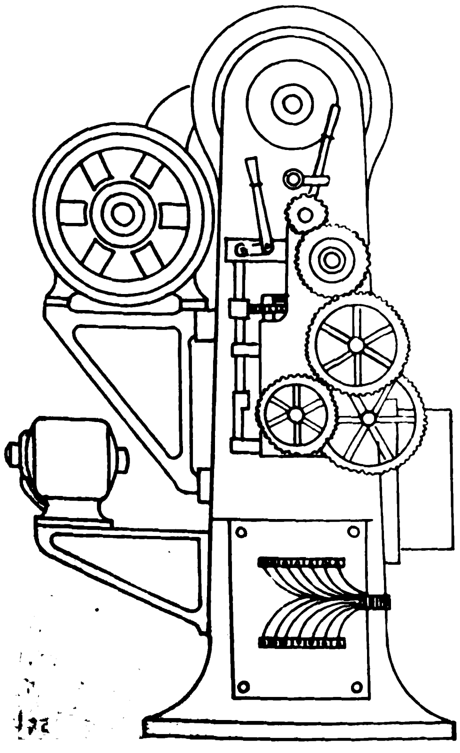

FIG. 8.

The independent motors admit of placing this machine near the side or end walls of the shop where the floor is more firm than near the middle of the room, whereas I have seen them placed in very unsuitable places because they must of necessity be placed near the line shaft to be belt driven. In some cases it has been necessary to build special piers under these machines in order to make it possible to use them and turn out good work.

Other illustrations from machine shop practice might be presented, but enough has been shown to demonstrate that with this kind of power transmission many advantages can be secured that are not a part of any other system, therefore it becomes necessary for all who wish to secure their share of work along this line to prepare for competition with those who are thoroughly up-to-date.

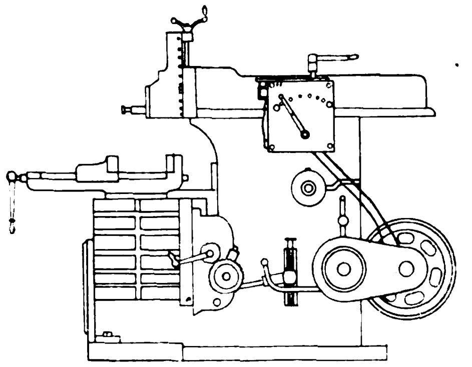

FIG. 9.

STREET CABLE SYSTEMS.*

BY S. J. WATSON.

In an electrical power plant the capital outlay on feeder, distributor, and service cables usually represents about two-fifths of the total expenditure.

The large investment involved, coupled to the fact that the satisfactory maintenance of the supply depends so much on the absence of faults and leakages makes it necessary that careful consideration should be given to the design and arrangement of such systems.

Serious breakdowns to the generating plant or accessories causing interruptions in the supply are fortunately rare, which speaks well for the attention given to this portion of the undertakings, but the technical papers almost weekly report a failure of the supply in one town or another through defective mains.

The old saying "Out of sight, out of mind," has doubtless something to do with the development of faults to the breaking down point, as the cables lie buried below the surface of the street and cannot receive the same inspection as the other plant. All cable systems may be divided, broadly, into two classes: 1, Draw-in systems; 2, Solid systems.

A third type, what might be termed a semi-solid draw-in system as represented by the Brookes system, which consists of a closed metallic pipe or conduit into which insulated cables are drawn and the whole filled up with a heavy grade oil, has been used to a small extent. The principle is in many ways a good one, but it necessitates a continuous supply of oil under pressure, and this proves difficult and costly to maintain on account of leakage.

It is also difficult to classify under either of the above headings the various systems of bare copper in iron, stoneware, brick, or concrete conduits. The conductors are invariably copper tape from an inch to an inch and a half wide and an eighth to a quarter of an inch thick, resting on porcelain insulators fitted to the conduit every 3 or 4 feet. Heavy sections are made up of several tapes laid together. When the strip is laid on edge it must be considered a solid system, as the strip is wedged to the supporting and to the jockey insulators to prevent side sag, but if laid flat and strained up into junction boxes it may be claimed as a draw-in system. To insure the satisfactory drawing in of additional strip, the conduit must be laid reasonably straight and be provided with inspection boxes at frequent intervals.

A large amount of town lighting work has been carried out in the past with bare copper, and fairly satisfactory results are still being obtained with pressures up to 460 volts.

For heavy sections it is undoubtedly cheap, but owing to the increase in pressures from 110 to 220 volts and the consequent decrease in the sections required, and also on account of the large reductions in the cost of insulated cables, this advantage is not now of so much importance as it was 10 years ago.

The troubles experienced with bare copper have been caused principally through the leakage of water into the conduits from burst water-pipes or flooded sewers. Such occurrences not only lead to heavy leakages and the decomposition of considerable quantities of objectionable liquids, but it necessitates the subsequent opening up of the length to clean insulators, copper and conduit.

In many instances disastrous results in the way of blown-off street boxes have occurred, due to accumulations of coal or other explosive gases being ignited by the sparking across defective insulators. Trouble has also resulted from the wave action set up in the conductors when heavy intermittent currents or short circuits have had to be handled.

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*Abstract of paper read before the Institution of Electrical Engineers Manchester, Eng., November 28, 1905.

DRAW-IN SYSTEMS.

Under this heading must be placed all systems with the cables drawn into pipes or conduits manufactured of wrought or cast-iron, stoneware, concrete, bitumen, fiber or other materials with one or multiple ways.

A single cast-iron pipe was probably the first to be used for the purpose. It offers several advantages, such as mechanical strength, long life, and is easy and convenient to lay with either spigot and socket, lead or rubber ring joints.

Wrought-iron pipes have been used, but in some soils it has but a short life, and may require frequent renewal.

For concentric or multicore cables either of the above-mentioned single way pipes may be used, but with a number of single cables, it is better practice either to use a separate pipe for each cable, which increases the cost or alternatively a multiple way conduit.

Multiple way cast-iron conduits can be obtained, but the cost is prohibitive except for quite special work owing to the difficulty in casting each way perfectly smooth and true.

Bitumen conduits with multiple ways have been used to some extent, the joint between lengths being made with molten bitumen compound after inserting an expanding mandrill into the ways to secure alignment. This material was not sufficiently strong and rigid to maintain its shape and with a slight increase in temperature through an overloaded cable or other cause was liable to collapse and form practically a solid system.

Probably the most largely used conduit with two or more ways are those made of stoneware. The cost is reasonable, the mechanical strength is sufficient for most positions without further protection, and its insulating properties are good. The material is, however, somewhat brittle and liable to damage when the ground is afterwards disturbed for other purposes, and as the lengths are from 2 to 3 feet it is difficult to support if a cutting of any considerable width is required under it. The joints between lengths of stoneware are made in several different ways. One maker adopts an expansive mandrill for centering, and uses a molten composition of bitumen and sand or ordinary cement outside a lapping of cloth, in both cases a cradle being used under the joint. Another maker uses a dowel for centering and cement for the joint. The type most generally used at present is provided with what is practically a bored and turned joint with the bedding faces of both spigot and socket made up of a pitch or bitumen compound. To make a watertight joint between lengths when laying the faces must be painted with a mixture of resin and tallow or of Stockholm tar and lightly hammered the lengths together. This method effects a considerable saving in time compared with other molten bitumen or cement, which delays the work while the materials set.

Multiple way concrete conduits have been extensively used for multicore air space telephone cables, the joints being made with cement.

A continuous conduit constructed of concrete has recently been designed and has been adopted by several supply undertakings. The leading features of the system consist of light gauge iron piping which before being used for the formation of the conduit is coated with a compound possessing a low melting point and good lubricating qualities. The pipes are screwed together and laid in the trench with suitable wood spacing bearers and the concrete is filled in, under, around and over the pipes. After allowing sufficient time for the concrete to set a steam jet supplied from a small boiler through a flexible pipe, is applied to the interior of the pipes, which causes the compound to soften and permits of the withdrawal of the pipes length by length. Some of the compound is retained by the surface of the concrete and presents a smooth surface for the cable when drawing in.

Cement-lined light gauge wrought pipes have been used largely in America, and also in England where work has been carried out by American contractors. The pipes are usually laid in concrete. Where cables are to be bunched together in one pipe this system may be cheap, but as this is not desirable, and the cost of several pipes would compare unfavorably with multiple way conduits, no special advantages appear to be offered by this system.

One of the latest design of pipes for draw-in systems is made of a patent fibrous material which possesses high insulating properties. It can be obtained of a light gauge with spigot and socket joints for laying in concrete or of a heavier gauge with screwed joints for laying direct in the ground without further protection. The material appears a very suitable one for the purpose, and its working under every-day conditions will be watched with interest.

A draw-in system of any kind is usually more difficult to construct than a solid system. Changes of level have to be arranged for to allow of the drainage of water from the ways. Boxes for drawing in or out must be provided at the corners of all the principal streets, at all changes of level and at intervals of 60 to 80 yards.

A small, but important matter with all draw-in systems is the provision of suitable ends to the ways at all street boxes. For this purpose hardwood bell mouthpieces turned or shaped to fit the ways can be used at little expense, the wood being first treated with Stockholm tar as a preservative. Faults on the cables of a draw-in system frequently occur at the street boxes through damage to the insulation, and attention to a small detail such as this will tend to reduce maintenance charges.

SOLID SYSTEMS.

The least expensive of all solid systems is armored cable, which consists of single, concentric or multicore insulated cables, with or without a lead covering and protected overall with steel tapes or galvanized iron or steel wires with a compounded serving outside, the complete cable being laid direct in the ground with a wood board over it as a protection. Such a cable can be quickly laid, and its flexibility is very useful in avoiding the usual obstructions met with under ground. In natural soil, such as gravel, sand or clay, satisfactory results may be obtained, but it is quite unsuitable without additional protection for laying in the made-up ground usually found in the main streets of our towns, as the armoring will be quickly destroyed and leave the insulation unprotected.

One of the largest used solid systems is made up of a wooden trough with wooden bridge pieces for supporting the cables, the whole being filled with molten bitumen. All the woodwork must be thoroughly impregnated with Stockholm tar. The usual preservative compounds used by building contractors for woodwork is not suitable for this purpose, as it has a deleterious action on the bitumen and some kinds of insulation. For the protection of the trough against future excavators a wooden trough, stoneware, tile, or old bricks may be used. Wood makes a very suitable covering carefully nailed to the sides of the trough. Tiles or bricks are apt to be displaced subsequently and leave the bitumen exposed.

(*To be concluded.*)

Proposals Invited.

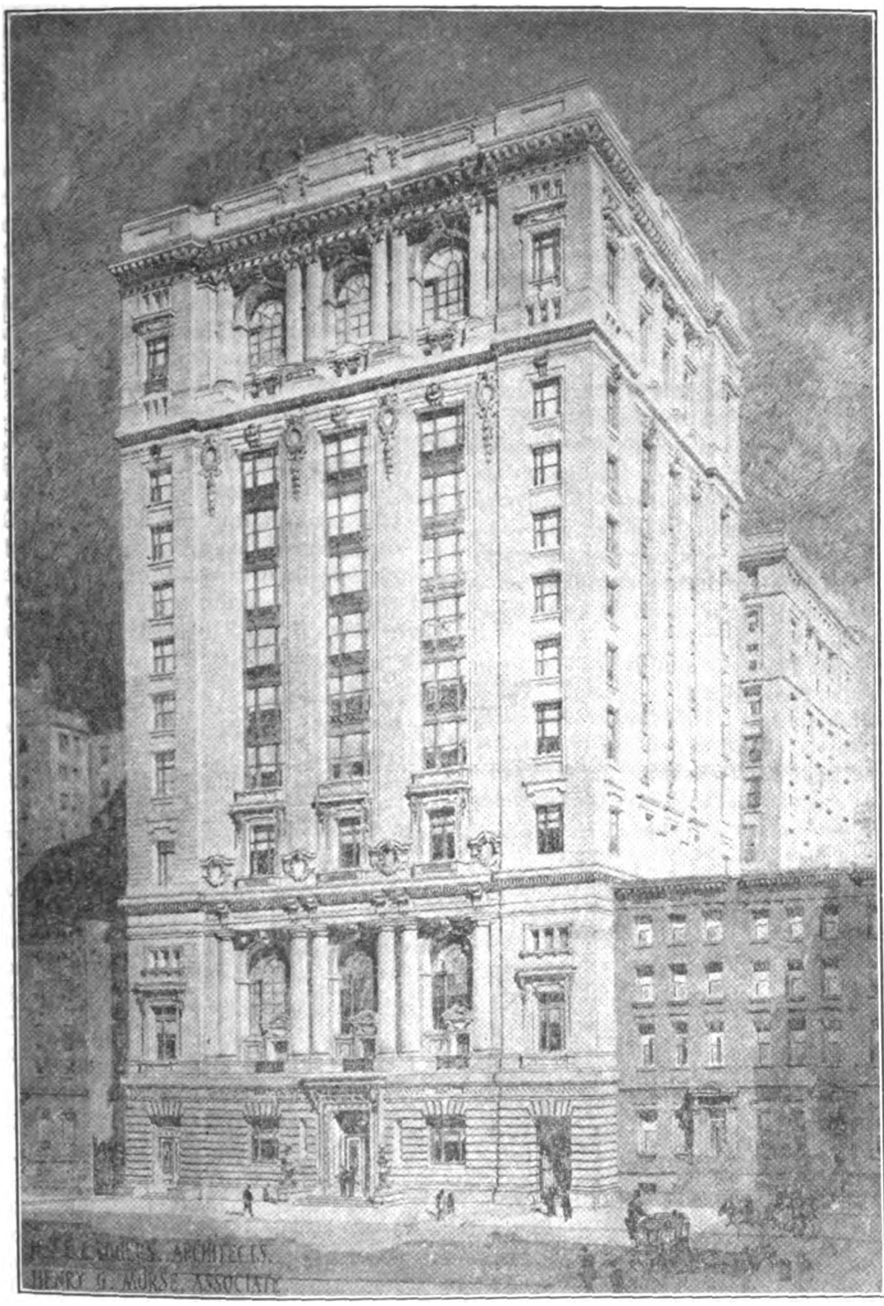
The Navy Department through the Bureau of Supplies and Accounts is inviting sealed proposals until December 26 for furnishing Eastern Navy Yards with the following supplies: Schedule 269, motor generator sets, conduit and fittings, wire, and miscellaneous electrical supplies; schedule 270, electric heaters; schedule 272, electric soldering irons. Specifications and proposal blanks can be obtained at the navy pay office in New York or upon application to the Bureau at Washington.

On January 9, 1906, the Bureau will open bids for furnishing Western Navy Yards with the following: Schedule 276, motors, cable, circuit breakers, electrical supplies. Proposal blanks and further information can be obtained upon application to the Bureau.

The Bureau will also open bids on January 9 for furnishing Eastern Navy Yards with machine tools as follows: Schedule 281, electric hoist and runway; schedule 282, electric driven motor outfit, arbor press, milling machine, etc. Blank proposals can be obtained at the navy pay office in New York, or by applying to the Bureau.

The War Department, through the constructing quartermaster at Vancouver Barracks, Wash., is inviting sealed proposals until December 30, for furnishing electric light fixtures, wattmeters and transformers for three buildings at that post. Full information will be furnished intending bidders on application to the constructing quartermaster at the above named post.

THE ENGINEERING BUILDING.



Perspective of the Engineering Building, looking northwest, to be erected on 39th street, between Fifth and Sixth avenues, New York City. It covers five city lots, and is presented by Mr. Andrew Carnegie for the American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers and the Engineers' Club.

Non-Resident Lectures at the University of Minnesota.

Mr. J. M. S. Waring, of Chicago, gave a lecture before the Senior Electrical Engineers at the University of Minnesota upon "Storage Battery Engineering," on December 5, 1905. Mr. Waring outlined the principal uses of the storage battery, discussed the methods of operation, booster, and the advantages of the battery as a central station auxiliary.

As a concrete example of storage battery engineering, Mr. Waring discussed the reasons for the adoption of storage batteries by the Elevated Railway Companies in Chicago, and followed out in some detail the method of determining the location and method of handling the same.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED DEC. 5, 1905.

Electric Lights and Appliances.

806,409. Portable Electric Lamp. John H. Goehst, Chicago, Ill., assignor to the Federal Electric Company. Filed Feb. 16, 1905.

806,516. Electric-Light Hanger. Hugh R. Berry, Greenville, Miss. Filed July 20, 1905.

806,723. Incandescent Electric Lamp. James C. Wormley, New York City. Filed Jan. 13, 1901.

Telephones and Telephone Apparatus.

806,276. Trick Telephone Toy. Edward G. Myers, Lincoln, Ill. Filed Jan 31, 1905.

806,284. Mouthpiece Attachment for Telephones. Metta F. H. Phillips and William B. Hubbard, Boston, Mass. Filed March 6, 1905.

806,339. Telephone-Shelf. Joseph S. Gold, Jackson, O. Filed May 20, 1904.

806,372. Telephone Attachment. Joseph Silverman, San Francisco, Cal. Filed May 26, 1905.

Miscellaneous.

806,173. Electric Furnace. Romaine W. Myers, Fruitvale, Cal. Filed Feb. 14, 1905.

806,238. Signal Apparatus. Clarence W. Coleman, Westfield, N. J., assignor to the Hall Signal Company. Filed July 1, 1905.

806,319. Automatic Signal. Andrew B. Burt and Frank T. Vanatta, San Francisco, Cal. Filed June 5, 1905.

806,332. Electric Clock System. Martin Fischer, Zurich, Switzerland, assignor to the Actiengesellschaft "Magnet," same place. Filed July 5, 1900.

806,363. Magnetic Tachometer. Edwin H. Porter and Burleigh Currier, Philadelphia, Pa. Filed June 17, 1905.

806,412. Telegraph-Repeater. Francis W. Jones, New York City. Filed Sept 21, 1905.

806,560. Electrical Measuring Instrument. Edwin F. Northrup, Philadelphia, Pa., assignor to the Leeds & Northrup Company, same place. Filed May 12, 1905.

806,574-575-576. Process of Making Insulated Wires, Insulated Wire and Process of Insulating Electric Conductors. George H. Rupley, Schenectady, N. Y., assignor to the General Electric Company. Original application filed Dec. 16. 1902. Divided, and this application filed Jan. 15, 1904 and March 1. 1905.

806,588. Electrical Insulator. Herbert Sinclair, Trenton, N. J. Filed May 5. 1905.

806,690. Electrical Ring-Furnace. Karl Meiser, Nuremberg. Germany. Filed April 26, 1904.

THE TELEPHONE WORLD.

To List Keystone Telephone Voting Certificates.

The voting trustees of the Keystone Telephone Company have filed application with the Philadelphia Stock Exchange for the listing of the $2,750,000 voting trust certificates. These represent an equal amount of common stock deposited with the trustees. The listing of the certificates will more than double the amount of Keystone common stock now available for trading, which aggregates 100,000 shares of the par value of $50, of which 58,000 shares are deposited with the voting trustees.

News from Milbank, S. D., states that at a recent meeting of the directors of the Grant County Telephone Company it was decided to extend the line from its present southern terminal, Stockholm, in South Shore, Codington County, and from there northwest to Summit. This will mean 35 miles of new line. Construction work will begin as soon as the weather permits.

Application was lately received by the board of governors of the Columbus, O., stock exchange for the listing of the securities of the Newark Telephone Company, the Independent company, which operates in Newark, O. The company will issue $50,000 of preferred stock which the brokers of Columbus will place for it. The preferred is paying 6 per cent. dividends, while 8 per cent. is paid on the common stock.

The Mountain Telephone Company, to operate in southern Berks County, Pa., has been organized by farmers and merchants. Work on constructing the line will be begun at once.

The East Lindley, N. Y., Telephone Company lately held a meeting to elect officers for the coming year. Sidney Griswold was elected president; William Griswold, vice-president; Bert Herrick, secretary; Abraham Brockhart, treasurer, and Fred Groom, director.

The Peninsula Telephone Company of Detroit, Mich., has made an agreement with the Oakland Telephone Company of Pontiac, to construct copper circuits, to be run through the Pontiac office and at Holly.

In Pierre, S. D., the total telephone tax for this year is $13,630.34, which is a decided gain over the tax paid a year ago, when $8,634.15 was what was required of the companies.

The Georgia Telephone Company has announced that its subscription list has recently increased to the number of 3,275 subscribers in Savannah.

The telephone question is being agitated again with very good prospects of securing a line through Leonard Bridge connecting with Lebanon, Conn.

The Idaho Independent Telephone Company of Boise has advertised for bids for the construction of a telephone exchange building.

The Interstate Telephone Company has begun the work of making extensive improvements to its system in Dolgeville, N. Y.

Growth of Farmers' Telephone Company.

The board of directors of the Baiting Hollow & Roanoke Telephone Company of Riverhead, N. Y., has voted to ask the stockholders to authorize the increase of its capital stock from $20,000 to $50,000, and it is believed that this will be done in the near future.

This company, started by farmers a few years ago to connect their farms throughout the rural districts, is having a phenomenal growth. It began with $5,000 capital. Only two or three years ago this was increased to $20,000, and now a large further increase is wanted.

In the beginning the farmers, in addition to operating the company themselves, built its own lines and installed its own 'phones. But lately the business has been increasing so rapidly that Joseph C. Backus, an expert, was put in charge as superintendent. The company had not been going long before it was found necessary to get into Riverhead with its lines. From that place the lines have rapidly spread in all directions, until now every village within a radius of a dozen miles is connected with its large central station, Riverhead. The farmers first put in the line as one of the up-to-date farming schemes and they believe it has been a money-maker for them on farming questions alone; beside this the company has annually paid big dividends to the stockholders. The increased capital will be used to extend the company's business.

Messrs. W. R. Fanning and H. R. Talmage recently met at Port Jefferson to make the final arrangements for an interchange of service with the North Shore & Suffolk Telephone Companies. Soon the local company will have a service all the way to Patchogue and various other south side and north shore villages.

The Springfield Home Telephone Company was recently incorporated under the laws of Tennessee with a capital stock of $75,000. The following officers were chosen: Thomas Pitt, president; John McMurry, vice-president; A. L. Dorsey, secretary, and H. T. Stratton, Jr., treasurer. Offices are being fitted up, and the construction of the system will begin at once. Much interest is being manifested in the enterprise by the public, and the venture has every evidence of being successful.

The Jacksonville Telephone Company, of Jacksonville, Ark., has filed a certificate increasing its capital stock from $1,000 to $10,000. S. W. Murtishaw is president, and Minnie S. Stone secretary of the company.

At a meeting of the board of directors of the Maryland Telephone Company of Baltimore, to be held the last Thursday in this month, the president, H. W. Webb, will retire from that office. He will be succeeded by Vice-president David E. Evans, who was Mr. Webb's predecessor.

The recently incorporated Franklin Telephone & Telegraph Company has about completed the construction of a telephone line from Quakertown to Riegelsville, Pa., with Springtown as its center.

Telephone Service Extended.

The recent deal by which the Citizens' Telephone Company of Cambridge City, Ind., obtained control of the Hagerstown telephone plant, is one of importance to that section. The two exchanges are being reconstructed, and when united free service will be extended to the patrons of both companies. The consolidation increases the number of 'phones to almost 1,600. The lines cover a strip of territory from Losantville, on the north, to within four miles of Connersville on the south, a distance of nearly 30 miles, and has direct connection with the entire Independent telephone system of the State.

The Citizens' Telephone Company of Terre Haute, Ind., an Independent concern, has purchased a block for its new exchange at a cost of $4,500. The property has a frontage of 45 feet and is excellently situated. Plans are being prepared for the erection of a new brick building three stories high, which will be as near fireproof as modern construction can provide. This will insure the absolute safety of the operating mechanism from fire risk. An elaborate switchboard will soon be installed, which will embrace all the features of up-to-date design, and it is estimated that the expense of erecting and fitting the building will reach as high a figure as $100,000. When this has been completed the Independent company will be in a position to furnish the highest class of service to the citizens of Terre Haute and vicinity.

The Columbus, O., Citizens' Telephone Company has recently installed an immense long distance switchboard, which is said to be the largest switchboard for long distance business installed in any Independent plant in the country. It will have 32 operators' positions, and will start in with 60 long distance lines, 32 Franklin County exchange connections and 60 rural and suburban connections. The company is also installing automatic telephones at the rate of 15 a day, and would put in 100 a day if it could obtain the necessary facilities and men. It is said that the scarcity of these ever since the new automatic system has been installed, has been a serious handicap to the extension of the system, so great have been the demands for the company's service.

The Mount Oarroll Mutual Telephone Company of Mount Carroll, Ill., was lately incorporated with a capital stock of $5,000, to operate a telephone system. The incorporators are Otho Watson, W. K. Stakemiller and Dan. S Mackey.

The improvements in the telephone exchange at Marlin, Tex., during the past few months have been extensive. Cables have been strung on all changes made looking to an up-to-date system.

The Summerville Telephone Company has finished the work of rebuilding its lines in Williamsport, Pa., and the service is now in an excellent condition.

J. L. Sayre, of Richwood, O., is organizing a telephone exchange for Ostrander and the district between Marysville and Delaware.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Andrews, Ind.—Nichols & Thornton have been granted a franchise to establish an electric light and waterworks plant.

Arcadia, La.—The plant of the Arcadia Electric Light Company was lately destroyed by fire.

Brillion, Wis.—The Brillion Electric Light Company has been incorporated with a capital stock of $20,000, by C. W. Behnke, O. C. Behnke and others.

Buffalo, N. Y.—The Referendum League, according to one of its members, will at an early date have one of the aldermen introduce a resolution directing the commissioner of public works to obey the recent vote of the people relating to a municipal electric light and power plant.

Canton, S. D.—The Canton Milling Company will sell $20,000 bonds to Eastern parties to enable it to put in a new electric light plant and waterworks system.

El Reno, Okla.—The El Reno Gas & Electric Light Company has been incorporated with a capital stock of $150,000 by George J. Hickox, F. N. Howell and others.

Fort Ann, N. Y.—The Wall Knitting Company will install an electric light plant.

Fort Morgan, Col.—This place will soon hold a special election to vote on the question of issuing bonds for the purpose of building and operating a municipal electric light plant.

Gilroy, Cal.—The Tracy Engineering Company has the contract to construct an electric lighting plant here.

Hyattsville, Md.—A bill will be prepared for passage at the coming session of the Maryland Legislature authorizing this town to borrow sufficient funds with which to install an electric lighting plant in the town for street and commercial lighting.

Marseilles, Ill.—Messrs. V. J. Duncan and J. J. Joy, of Ottawa, contemplate establishing a gas and electric light plant here.

New York City.—It is currently reported that this city will buy a piece of land 300 feet square at Port Richmond, on which to establish an electric lighting plant for all the street and public buildings of Richmond Borough.

Peru, Ind.—Capitalists of this city have obtained a franchise for an electric light plant at Arcadia, and the same plant will be used in providing electric lights for the streets of Atlanta, three miles distant.

Princeton, W. Va.—William E. Fowler, president of the American National Bank of Graham, has made application to the council for a franchise to erect an electric light plant here. Mr. Fowler binds himself to have his machinery on the ground within one month and the plant in operation by the first of June.

Pittsburg, Pa.—This city has concluded to build its light plant. The council authorizes the appointment of a joint committee of seven to investigate and procure estimates of costs, etc.

Union, N. Y.—A proposition for an electric light plant is under consideration here,

Zionsville, Ind.—The Zionsville Water & Electric Light Company of this city has been incorporated with a capital stock of $10,000, to erect, operate and maintain waterworks and electric light plants. The incorporators are: V. A. Longaker, D. S. Menasco and M. E. Wiesehan.

STREET RAILWAYS.

Centerville, Ia.—The Centerville Light & Traction Company is now making a survey between here and Mystic, with the object in view of determining the possibility and practicability of constructing an electric railroad between the two cities.

Ellisville, Ill.—One of the Walsh Brothers is trying to find out the best route for an electric railway in this town.

Fairmont, W. Va.—The directors of the Fairmont & Fairview Traction Company, which purposes to connect this city with Fairview by an electric railway, a distance of 20 miles, has elected the following officers: President, E. L. Rutherford, Scottsdale, Pa.; vice-president, S. L. Dillinger, Baltimore; secretary, Charles E. Conway, Fairmont; treasurer, B. F. Overholt, Scottsdale.

Fisher's Island, N. Y.—Steps have been taken to petition the Legislature for a charter giving privilege to operate an electric line here. The line contemplated would be a narrow gauge affair, and have very small equipment, so could be built at small expense. It is believed that the traffic for it would be ample to pay a dividend on the small outlay proposed.

Florence, Col.—F. F. Granger, who recently looked over the county with a view of building an electric line from this city to Coal Creek, Rockvale and Canon City, says that the country is too sparsely settled for a road to pay from the start. As the property along the proposed line would be greatly benefited by the road, he asks a cash bonus of $45,000 to help along the enterprise, said bonus to be paid only upon completion of the road,

Geneva, N. Y.—While promoters in this vicinity have been discussing the advisability of constructing a trolley road between Lyons and this city, a party of local capitalists went to Albany and incorporated the Geneva, Phelps & Newark Electric Railway Company, for the purpose of constructing and operating an electric railway between this city and the village of Newark. The company is capitalized at $40,000. The road will be about 15 miles long.

Granite Falls, Minn.—Business men of this city and Canby are talking of a trolley line between the two places.

Gridley, Cal.—A prominent citizen lately expressed the opinion that Mr. Butters' proposition to build the electric road into this city for free right of way and free terminal would be speedily accepted. Definite action will shortly be taken by the Chamber of Commerce.

Hummelston, Pa.—The people of this city are circulating the report that a number of capitalists are planning for a trolley line between here and Middletown.

Mt. Holly, N. J.—It is reported that a Philadelphia banker has offered to finance the plan of extending the trolley line of the Burlington County Railway Company from this place to Pemberton by way of Smithville.

Mt. Sterling, Ky.—Younger Alexander, J. M. Bigstaff, John Collins and others have been granted the right of way to build and operate an electric line to this city from Paris and North Middletown.

Oxford, Pa.—A new trolley line is being built to this place and Kennett Square.

Philadelphia, Pa.—The first active steps toward building an electric line between Camden and Atlantic City have been taken by the West Jersey & Seashore in leasing part of its Newfield branch and the entire Somers Point branch to the Atlantic City & Shore for 40 years. An electric system will be established between Atlantic City, Pleasantville and Somers Point. It is the purpose of the West Jersey Company to electrify its Newfield branch between Pleasantville and Newfield, and to build an electric line between Camden and Newfield, paralleling the steam road which extends from Camden to Cape May.

Utica, Ind.—Ebenezer Howes, of this city, is at the head of a movement to build an electric line from this city to a connection with the Louisville & Southern Indiana Traction Company,

POWER PLANTS.

Cobourg, Ont.—The Northumberland-Durham Power Company, Limited, with a capital stock of $750,000, has received a charter to construct and operate works for the distribution of electricity. W. J. Crosson, J. A. Culverwell, C. Donnelly, W. McLean, S. Nesbitt, R. A. Mulholland, W. J. Maher, J. F. Clarke, E. T. Adams and Frank M. Field, are among the local and Port Hope gentlemen who are interested in this concern.

La Crosse, Wis.—Black River promises to become one of the leading water power streams in the Mississippi valley under disclosures recently made by the La Crosse Hydro-Electric Light & Power Company, when articles of incorporation were forwarded to Madison. The company is capitalized with $1,000,000.

Oceanside, Cal.—That H. E. Huntington intends to construct on Warner's ranch, about 20 miles from here, a large power plant, has been shown by the filing in the county recorder's office at San Diego, of a notice of appropriation on 50,000 inches of the waters of San Luis Rey River.

BIDS WANTED.

Los Angeles, Cal—The board of Education of this city will receive bids for the electrical indicating instruments for the new Polytechnic High School. All bids must be accompanied by a certificate check of 5 per cent. of amount of bid.

South McAlester, I. T.—Sealed proposals for wiring, heating, etc., for the Indian Consistory will be received until January 15, 1906, at the office of William Busby, chairman, this city.

Washington, D. C.—Proposals for a brick industrial building will be received until January 2, by the Department of the Interior, Office of Indian Affairs, this city, for furnishing and delivering the necessary materials and labor required to construct and complete a brick industrial building, also electric light and water sewerage plants.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 18⅝@18⅞c. Lake 18¼@18½c.; casting, 18@18½c.

The United Railways Investment Company of San Francisco preferred stock has been placed on a 5 per cent. dividend basis.

For the five months ended November 30, the Philadelphia Rapid Transit Company claims it is over $400,000 ahead of the corresponding period in 1904.

The General Electric Company has filed with the Secretary of State at Albany, N. Y., a certificate of increase of capital from $48,325,500 to $60,000,000.

The Pittsburg Railways Company has closed a deal for the purchase of the Washington & Canonsburg Electric Railroad for $475,000 cash and $600,000 in bonds.

The Interborough Rapid Transit Company has declared the usual quarterly dividend of 2 per cent. payable January 2. Books closed December 11, and reopen January 2.

The Chicago Telephone Company has declared a regular quarterly dividend of 2½ per cent., payable December 30. Books close December 26 and re-open January 2.

The Otis Elevator Company has declared the regular quarterly dividend of 1½ per cent. on its preferred stock, payable January 15 to holders of record December 30.

The Twin City Rapid Transit Company has declared the regular quarterly dividend of 1¾ per cent. on its preferred stock, payable January 2 to holders of record December 19.

The Strowger Automatic Telephone Exchange at Chicago has declared the regular semi-annual dividend of 50 cents a share, payable January 2. Books close December 23 and re-open January 4.

The Electric Company of America warrants have been placed in the unlisted department of the Philadelphia Stock Exchange. It has been ruled that commission on these warrants be 6¼ cents per share.

The Massachusetts Electric Companies has just issued its sixth annual report covering the year ended September 30, 1905. The report shows gross earnings, $6,734,127; expenses, $4,456,303; net earnings, $2,277,824; charges, $1,543,514; balance, $734,310; dividends, $372,448; surplus, $361,862.

The Vanderbilt-Andrews Traction Syndicate is said to have purchased the entire property of the Rochester Railway & Light Company, which will complete its control of all the traction lines, gas works and electric lighting plants of Rochester, N. Y. The transaction is said to involve $10,000,000.

Contracts have been let by Edwin and J. B. Hanna and other Cleveland capitalists for the construction of the Chicago, Lake Shore & South Bend Electric Railway, which will connect Chicago and Cleveland by trolley as well as Chicago and Cincinnati. The line is expected to be completed by the end of 1907.

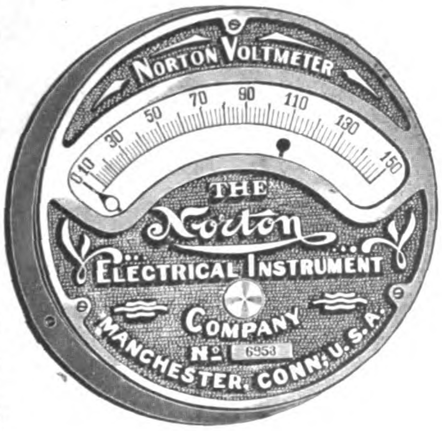
The statement of the New York associated banks last Saturday, while showing a deficit of $1,246,525 in surplus reserves was not what could be called a disappointment. At the same time, it makes evident the strained position of money in the clearing house center of the country. Some relief is afforded by the announcement that Secretary Shaw has authorized the payment of interest on United States bonds due January 1 and December 15. Account of interest anticipated is about $4,200,000.

ELECTRICAL STOOK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price Dec. 12
New York City.	
Broadway and Seventh Avenue	243½
Interborough Rapid Transit	211
Manhattan Elevated Railway	164
Metropolitan Street Railway	118⅝
Metropolitan Securities	73¼
Ninth Avenue	195
Third Avenue	123
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	86⅛
Brooklyn City Railway	243
New Orleans Railway	38
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	83
Philadelphia Traction	100⅞
Union Traction	62½
Boston.	
Boston Elevated	153
Massachusetts Electric Companies, com	15¾
do. do. do. pref	60⅛
West End Street, com	98
do. do. do pref	113½
Chicago.	
City Railway	205
North Chicago	85
Union Traction, com	13
do. do. pref.	40
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	22¼
do. pref.	63
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	15
do. do. pref.	20
Westinghouse, com	175
do. pref.	193¼
General Electric	183⅝
Boston.	
Edison Electric Illuminating	239
General Electric	183⅝
Westinghouse Electric & Mfg., com	85½
do. do. do. pref.	100
Chicago.	
Chicago Edison	163
National Carbon, com	76⅛
do. do. pref.	116
Philadelphia.	
Electric Company of America	11¼
Electric Storage Battery, com	82¾
do. do. do. pref.	81
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	135
Western Telephone Company	13¼
New England Telephone Company	134
New York.	
American Telegraph & Cable Company	91
Commercial Cable Company	210¼
Mexican Telephone Company	1⅝
New York & New Jersey Telephone Company	160
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93⅛
Chicago Telephone Company	138⅛
MISCELLANEOUS STOCKS.	
Chicago Subway	49⅛
Otis Elevator Company	63
Standard Underground Cable	..
Twin City Rapid Transit	51¾

NORTON SWITCHBOARD INSTRUMENTS.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THE Norton ELECTRICAL INSTRUMENT COMPANY
No 6953
MANCHESTER, CONN. U.S.A.

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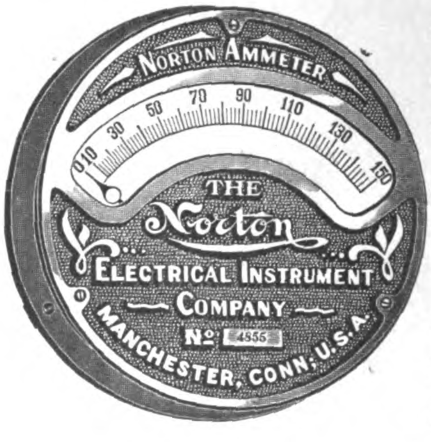
0 to 1500 amperes.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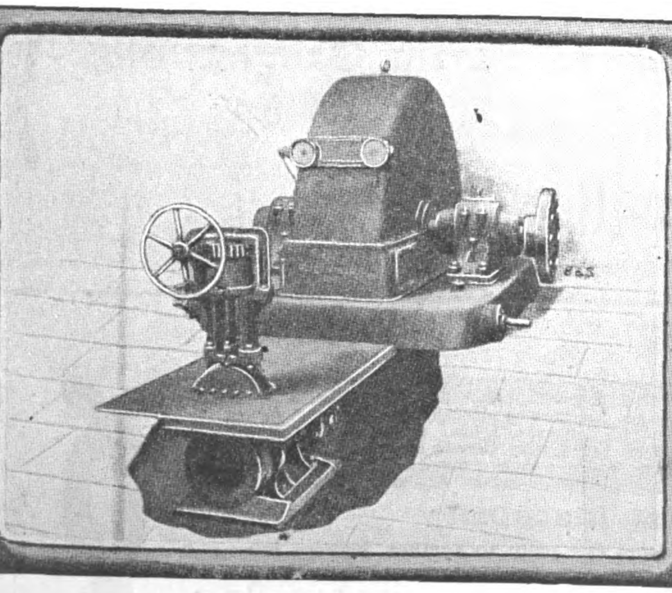

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ELECTRICITY.

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EDITORIAL NOTES.

The Electrification of Steamships.

Not very long ago, the "Great Eastern," then called the "floating city," was supposed to represent the climax of steamship development as far as size and equipment were concerned. It was a side paddle steamer of great dimensions, with what was then considered every facility for passengers' comfort, and the making of rapid progress across the water. It may be remembered, that the first Atlantic cable was uncoiled from its hold and laid across the ocean, due to the spirit of enterprise animating the breasts of Cyrus Field and his colleagues.

The first great transatlantic steamer was therefore identified from the start with the greatest electrical project under consideration—the welding together of the American and European Continents. The "City of Bremen," another steamer crossing the Atlantic, became unique as the first ship to be equipped with an electric light plant. The success of the large steamship, of its accessories in the way of mechanical and electrical additions, soon paved the way for a series of improvements, that eventually became established factors in its general equipment. To-day this equipment is so varied in character that it may be said to mark two general lines of progress: one in the way of mechanical improvements; the other in the way of electrical advancements. The latter are in certain respects more startling in their purpose and application than the former. They represent inventions not only in the way of light and power, but remarkable forms of mechanism for signaling and receiving messages. The idea presented here may be said to embrace what can be consistently called the electrification of steamships. By this is not only meant the use of electricity to the purposes of personal comfort, but its use for the improvement of transatlantic service to an extent hitherto undreamed by the most imaginative of novelists. In this last respect, as a matter of verification, may be mentioned the printing of a newspaper, containing all the important items of American and European life. The development of a distinct press service at an inaccessible point on the ocean surface, means the concomitants of such a service. It means an ability to reach and communicate with either shore. It naturally adds an element of safety to ocean travel hitherto absent. It therefore improves the service to an extent which removes many of the terrors once associated with the phrase relating to "those that go down to the sea in ships."

The searchlight for signaling at night to nearby vessels has been a boon to the navigator. The wireless telegraphic device for reaching the farthest and darkest recesses of the ocean's surface has prevented isolation from civilization. The electric lighting, heating and hoisting apparatus has transformed the interior of the latest type of marine architecture into floating hotels. These things, with which we have become so very familiar, have been inaugurated by the possibilities of electricity. Fire risks in consequence are all concentered. Of all the awful possibilities of ocean travel, this, the risk of fire, has been reduced to a minimum by the replacement of oil lamps by the incandescent. Thus the electrification of steamships does not mean the singing of a note of praise, because they have been dominated by applications of electrical energy. But it does mean a new realization of benefits to life and limb, to health and happiness, of the many advantages in the way of hygienic surroundings that it permanently secures. It has been the means of encouraging ocean trips because, to use a popular phrase, "all the comforts of home" are by its means developed to their utmost. An ocean steamer of modern type is thus a great floating hotel, as much in certain respects a part of the soil, as though it were firmly imbedded at any of the noted resorts of amusement or health.

* * *

Adopting the Metric System in the United States.

To adopt the metric system in the United States it will be necessary to educate the public not only to its use, but its value, as well. No opposition will be met on this score by those familiar with the units it represents. Members of the House Committee on Coinage Weights and Measures, are anxious to commemorate their work by an advocacy of this system for general adoption throughout the United States. Already a matter that has been legalized by Congress, Representative Littauer of New York is about to call for legislative enactment making the use of the metric system a law. We, as exponents of electrical engineering, regard this possibility with great satisfaction, but the confusion into which artisans and shop dealers will be thrown is what strikes our attention. It will be a tremendous task to accustom the illiterate to the meaning of such names and values. It will be a still greater task to have that meaning penetrate the precincts of domestic life to an extent which will render orders from there intelligible to the dealers providing them. A generation must live and die before the metric system will be firmly founded in the United States. Between this time and that people will be bound to think in the English system, though they may talk the metric. Until this is done, however, confusion must result between our German and French and American exporters.

* * *

Undeveloped Electric Lighting in France.

France is a country in which progress comes in waves; at one time the dominant power is science, at another time politics—then follow tidal waves of art, music and literature. The neglect of electric lighting in France is either due to a disregard of the value of the electric light or to a lack of enterprise in furthering its general utilization. A reference of this kind is only made because France not very long ago possessed the full leadership in the electrical science, both as regards theory and practice. The brilliancy of her workers made her noted in all countries; the names of Ampere, Arago, Deprez, Plante, Faure, are immortalized in the archives of scientific progress. But her recent work in electric lighting is left in the background, in comparison with the vast strides made by America, England and Germany. The facilities for making electric lighting a success are not any less in France than in other countries. If the argument is advanced that the interior of France is settled by peasants, whose wants are few, then the same logic applies to Germany, where electric lighting is done to a large extent in rural communities. Electric lighting in France is not undeveloped in Paris or Havre or other large cities. But where every small town in our own land as well as England and Germany are well equipped in this respect, France is behindhand.

Provincialism may be the ruling factor there to a greater extent than it is in either of the other countries, but if so, a system of propaganda is necessary to instill new ideas into the minds of the agricultural class. Electric lighting in any country is largely a matter of education, as far as its spread is concerned. Until active means are taken in this direction the interior of France will lack, in this respect, what the other countries enumerated are so well noted for.

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

Work is progressing actively on the proposition to merge the leading street car manufacturing concerns of the country.

◆

A high official of New Haven Railroad says that in his opinion within five years the entire passenger traffic of that road between New York and Boston will be conducted by means of electricity, not by the third rail or trolley system but by means of electric locomotives.

◆

Dr. Henry S. Pritchett has announced his determination to retire from the presidency of the Massachusetts Institute of Technology, a position which he has held for five years, as soon as a successor can be secured.

◆

The United States Consul at Bremerhaven reports that a wireless telegraph station which is being built by the German Government at Norddeich is expected to cover a circuit including nearly all Europe. It is intended to convey messages not only to and from Germany, Switzerland, France, Great Britain and Denmark, but also the larger part of Italy, Sweden and Norway, and even portions of Spain, the Balkan Peninsula, and Russia. To the southwest it will operate as far as Saragossa, in the south it will almost reach Naples and Cettinje, in the east get close to St. Petersburg, and in the north it will talk to the people at Drontheim and about half-way up to Narvik. The towers for the station are to be 213 feet high. The entire plant, including dwellings for the officials and employes, will be ready for working by the beginning of next year.

◆

It is announced that the Illinois Central Railroad Company will immediately begin the construction of a telephone system, extending from New Orleans to Louisville and from Fulton, Ky., to Chicago. Contracts have already been let for this work.

◆

The Central Pennsylvania Traction Company has placed an order with the Allis-Chalmers Company to supply all the steam and electrical machinery, aggregating 3,000 horse power, for its new plant to be located at Harrisburg, Pa.

◆

Dr. De Forest will establish a temporary wireless telegraphy station in the Coliseum, Chicago, during the electrical show, and will accept commercial business between there and Kansas City, St. Louis and New York.

◆

American electrical equipment is to be installed in the nitrate plants of Chili, S. A.

◆

During the month of October Germany mined 10,790,000 tons of coal against 10,370,000 in the previous month, further 4,870,000 tons of lignite against 4,550,000. It produced 1,490,000 tons of coke against 1,070,000 in September, and 1,160,000 tons of briquettes against 1,050,000.

◆

Mr. Carnegie has promised to equip at an expense of $100,000 the Electrical Engineering Building of Union College in Schenectady, N. Y., providing the college raises another $100,000 to endow it.

◆

Five sugar plantations in Cuba are about to be equipped with electrical machinery, which will represent an expenditure of $200,000.

IMPROVED ARC FURNACE FOR MAKING SYNTHETIC DIAMONDS.

BY A. FREDERICK COLLINS.

The successful industrial applications of the electric furnace have opened a new field in chemistry, and the arc furnace, which is one of the three types available, has proven a means of obtaining temperatures so exceedingly high that it is not only possible to break down certain combinations, resolving them into simpler bodies, but also to build up other elements into new compounds.

In various preceding issues of ELECTRICITY, editorials and articles have appeared from time to time relating to the ingenious researches of M. Henri Moissan, of Paris, who was enabled by means of high temperatures and exceeding pressures to produce real diamonds, though these were of microscopic size. Since these famous essays of the French physicist other workers have striven to excel the product by improving the process, the latest claimant in the field being Mr. Henry W. Fisher, chief engineer of the Standard Underground Cable Company of New York.

The arc furnace in which the miniature gems are produced is formed by an electric arc in air between two carbon electrodes, similar to the arc light. When in operation there is a definite limit to the length of arc which can be maintained with a given current strength, and again the limit which at first increases very nearly in proportion to the current strength, does so slowly as the current density reaches higher values, and in virtue of this fact the length of the arc is limited. The temperature of the carbon terminals may reach a value approximating 3,500 degrees centigrade, which is practically the point at which carbon volatilizes when under atmospheric pressures. The incandescent gases of the arc reach a temperature of at least 1,000 degrees higher, and hence it follows that the arc furnace is particularly adapted for subjecting the small charges of iron and carbon necessary in making diamonds to the highest temperatures available.

Briefly, Moissan's method of crystallizing carbon is to place within the electric furnace a crucible of molded carbon, the electric arc being formed between the carbon terminals directly over the opening of the crucible. A small quantity of soft iron and pulverized graphite, the latter to be converted into the diamonds, were put into the crucible, the compound being finally covered with charcoal. A current of 1,000 amperes and 500 volts produced the arc between the carbon electrodes, which were 2 inches in diameter, and under the terrific heat evolved the graphite was brought to a temperature capable of fusing it.

When this result was attained the crucible with its incandescent contents was lifted from the furnace and immersed in water, the sudden cooling causing the iron to contract and in turn this action exerted a sudden and mighty pressure on the graphite. The fused graphite distributed throughout the molten metal was in consequence crystallized in the isometric system, having the density and other characteristics that distinguish diamonds from all other crystals. It has been found that the quicker the cooling process takes place after the maximum temperature has been reached the larger apparently and nearly perfect are the stones. It is evident, therefore, that in the experiments just cited a considerable loss of time results from the moment the furnace is opened until the liquid mass reaches the water or other cooling medium, and it was believed that if this could be reduced much better results would attend the work.

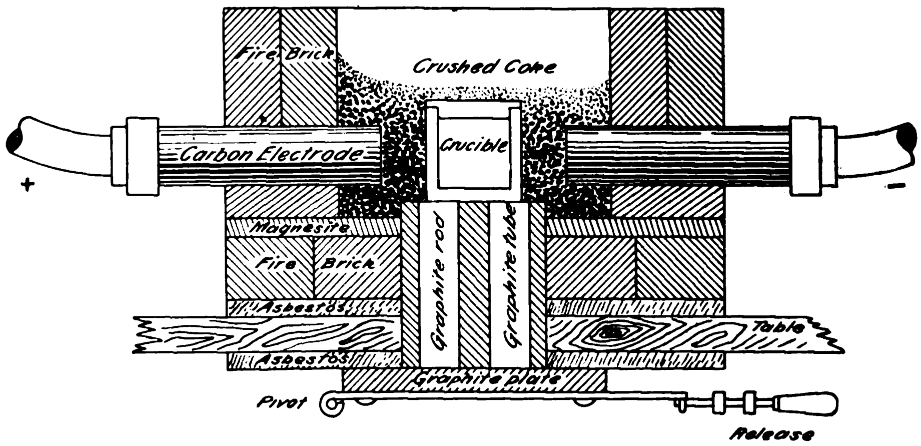


FIG. 1.

To provide means that would reduce the length of time required to transfer the crucible to the cooling medium, Mr. Fisher devised the furnace shown in Fig. 1, and which also enabled him to obtain a more intense and uniform heat. In the first place the table on which the furnace rested was well insulated from the heat with layers of asbestos, while the furnace itself was built up of fire-brick, and lined with magnetite; through the walls the graphite electrodes projected, the ends terminating on either side of the crucible and around which powdered coke was packed. In this manner much of the heat ordinarily lost where the arc takes place above the crucible is returned.

The lining of magnetite serves to distribute the heat set up in the interior of the furnace and thus the temperature of the exterior is considerably lowered. By referring to the cross-section, Fig. 1, it will be observed that a portion of the table immediately under the furnace has been cut away. The object of this is to permit the crucible and its contents to be dropped from the inside of the furnace when the critical period has been reached, and falling through a hollow cylinder of graphite only an instant is required to precipitate the seething mass into the cooling bath. The cross-sectional drawing also shows the simple device by which the crucible is released from its position inside the furnace; a hinged graphite plate having a releasing catch supports a rod of the same material, and on top of this rests the crucible; when the catch is drawn forward the graphite plate falls and the rod and crucible with it.

There is considerable danger attendant upon the immersion of an incandescent body in a fluid, and this very often results in violent explosions; this then was a feature that also had to be taken into consideration in devising ways and means for obtaining pressures. Several experiments with materials other than liquids were made and in some of the early ones a mass of lead having a large cavity drilled out of its center to contain the molten iron and the carbon suspended in it. This not proving over-successful a bath of the molten solder was tried, but this did not give much better results.

It was then the experimentalist returned to water as the best cooling agent and to utilize it to the best advantage he arranged a pivoted trap of asbestos to drop the crucible; disaster nearly attended these trials for the crucible in its fall turned partially over and projected its white-hot contents into the iron pot holding the water; striking the vessel at the water line there was a blinding flash, like miniature lightning, a terrific seething of decomposing water, and when the event was over it was found that the molten metal had burned a hole through the pot.

Fortunately, no one was injured nor any material damage done, but to prevent a recurrence of the untoward event, measures were at once taken to provide a course for the crucible that should in the future guide it in an upright position until it had come in contact with the water, and this eventually led to the graphite tube, as shown and described. When the superheated iron and graphite were treated to this sudden cooling process the now solidified mass broke up under the enormous strains, and it was in the portions that were broken off that the diamonds were found, while more were discovered in the larger portion that always remained in the crucible. The accompanying illustrations, Figs. 2 and 3, are micro-photographs of the gems, the first ever obtained artificially in the United States. The photographs shown were taken by reflected light, and indicate clearly the appearance of the product which is a colorless, transparent and crystalline form of diamond.

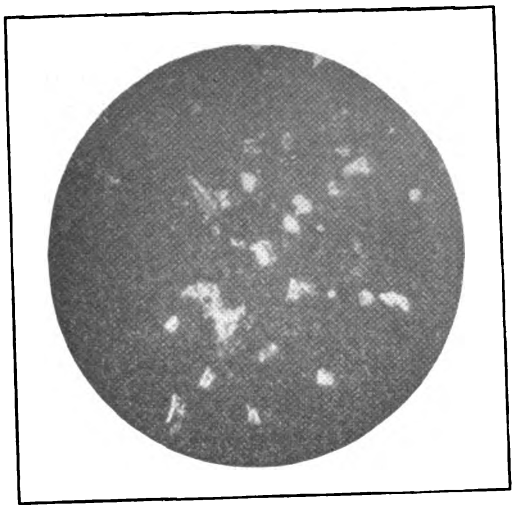


FIG. 2.

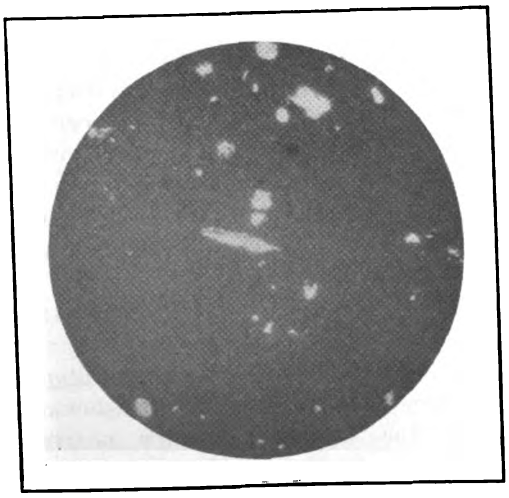


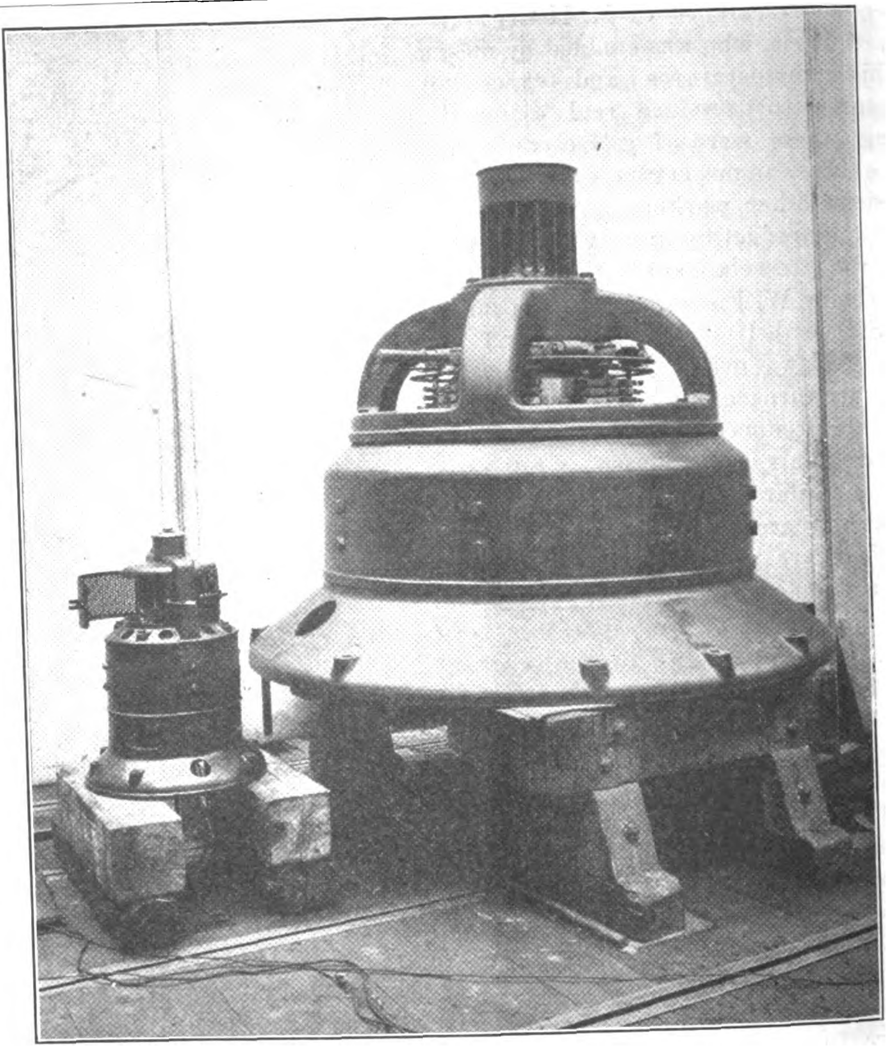
FIG. 3.

These are the most successful attempts to manufacture diamonds by the electric furnace method that have ever been made, and the diamonds though small are apparently of excellent quality. Although no stones that are large enough to be of commercial value have yet been prepared the problem is of fascinating interest, for it not only points out a method of making diamond powder for grinding purposes, but seems to mark the beginning as well of artificially making real diamonds sufficiently large for adornment.

Different from the electric incandescent furnace the temperature of the arc furnace is very difficult to regulate and in this may lay the secret of diamond manufacture, that is to say, there may be a certain critical temperature to which the graphite must be heated in order that it may crystallize when it is chilled by its contact with the water. As an illustration of the importance of heat regulation on other compounds Mr. Townsend cites the following:

"If a mixture of sand and coke is cautiously heated in an electric resistance furnace a partial reduction of the sand occurs and a product containing silicon, oxygen and carbon, known as "siloxicon" is formed; at a somewhat higher temperature the reduction is complete and there results an amorphous body, having the essential components of carbide of silicon and technically called "white stuff" At a yet higher temperature this amorphous body passes into the crystalline carbide of silicon or "carborundum," a compound approximating in hardness the diamond itself; while at still higher temperatures, approximating that of the arc furnace, this carborundum is broken down, its silicon escapes as a vapor and its carbon remains in the form of graphite.

The effect of high temperature upon reaction is two-fold; in the first place the velocity of the reaction is increased so that chemical charges which at lower temperatures occur slowly, or not at all, take place rapidly or even with explosive violence; in the second place new conditions of equilibrium are established and the chemical elements enter into that combination which under most circumstances sometimes gives rise to compounds not before known. To produce a given result, however, it is usually necessary to work within definite temperature limits and this is most likely



Paris Metropolitan Railway's 130 Hp. Vertical Shaft Pump Motor.

the case of making diamonds in the arc furnace.

In any event it would seem that the goal is not so far distant, and it is extremely probable that continued research will lead to a discovery that will not only greatly simplify the production of diamonds, but what is even more important, will place a far lower value upon them than at present quoted by the "Diamond Trust."

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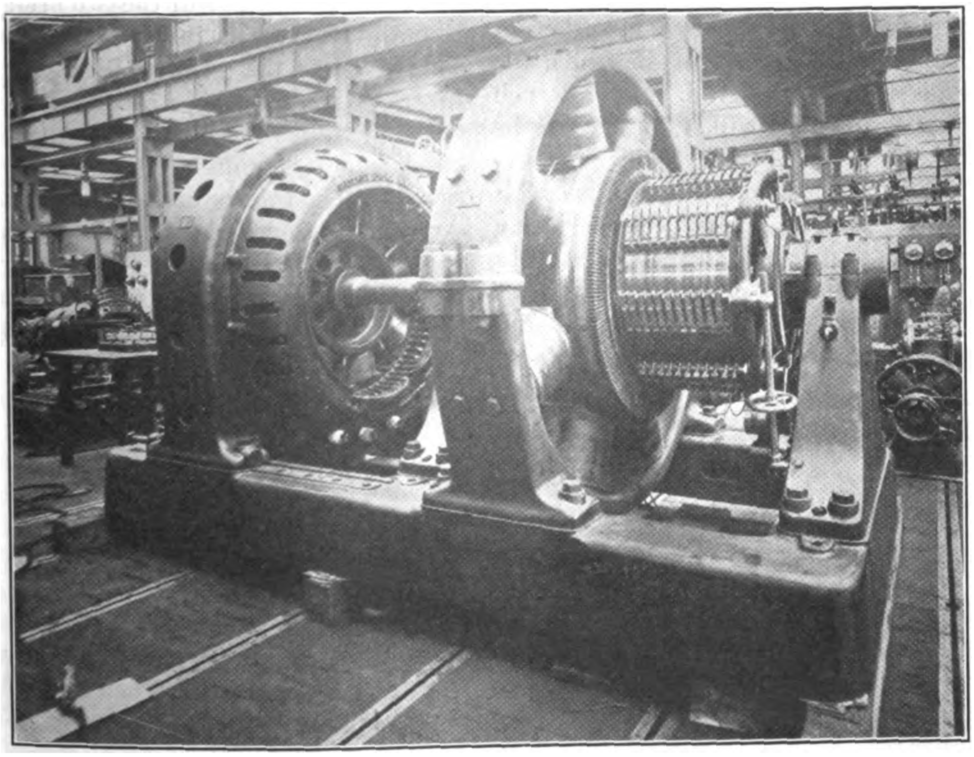
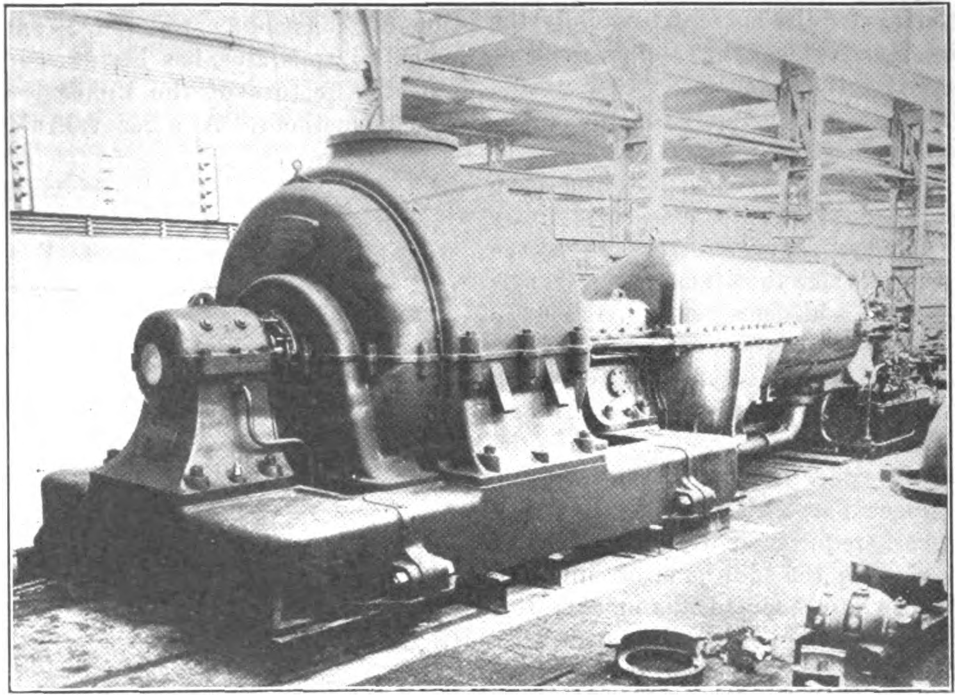
THE NEW TURBINE PLANT OF THE PARIS METROPOLITAN RAILWAY.

Early in January, 1906, another important section of the Paris Metropolitan Underground Electric Railway will be completed. For this and all future sections of this railway power will be drawn from the new power station which has for some time past been erecting at St. Denis, Paris. The original station which has been supplying the system since the year 1900, when electric traction was first used, will not be further enlarged, and its equipment will be continued as at present, aggregating 14,000 kilowatts or thereabouts. The second station has been built for a separate company, the "Societe de Railways et d'Electricite Brussels," formed by the Paris Metropolitan expressly for this purpose, and when the railway and original power station are taken over by the municipality at the termination of the concession, supply of energy, it is assumed, will still have to be obtained from this new company or else satisfactory terms arranged for equitable purchase.



Paris Metropolitan Railway's 375 Kw. Motor Generator.

The new St. Denis station already has two of its large sets running. They are of the Brown-Boveri–Parsons steam turbine, three phase alternator type, each for 5,000 kilowatts, and capable of developing 6,000 kilowatts. When the plant now on order for this undertaking is finished there will be 10 of these 5,000 kw. sets; they run at a speed of 750 revolutions per minute, and each weighs 150 tons. The turbines are built for a steam pressure of 12 atmospheres at the stop valve, and work with steam superheated at a temperature of 300 degs. The lowest vacuum is not to be below per cent. of the barometric pressure.



One of the 10,000 Hp. Steam Turbines for the Paris Metropolitan Railway.

The three-phase alternators will generate at a voltage of 10,000—10,500 volts, and the frequency will be 25 cycles per second.

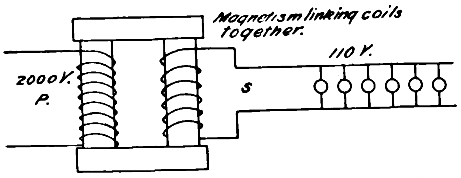
For each unit there is a surface condenser, whose air and circulating pumps are driven by a continuous current motor, and an oil pump (driven by steam) which supplies oil under pressure to the different parts of the turbine. The makers of the plant have guaranteed that the steam consumption shall not exceed 6 8 kgs. per kw. hour, when working under the above conditions. A better result than this is expected, as 6.8 kgs. have repeatedly been obtained with 3,000 kw. turbine sets.

For the first four turbo-generators the exciting current is obtained from a 300 kw. 220 volt continuous current turbo-dynamo, running at 2,700 revolutions per minute, also provided with a surface condenser. Two 375 kw. motor generators act as a reserve for the exciting current, and run also the various pumps for the condensing plants, the feed pumps, etc. The character of machine to supply the current to the six other turbo-alternators has not yet been settled. The accompanying photographs show one of the turbo-alternators, a 375 kw. motor generator, and a 130 hp. vertical shaft pump motor. The first view also illustrates a 7 hp. fire-pump motor.

LIGHT, HEAT AND POWER PRINCIPLES.—XIII.

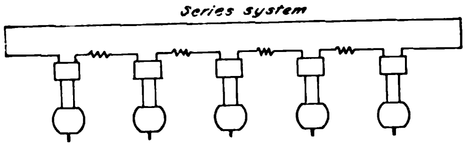
BY NEWTON HARRISON, E. E.

Regulation of Transformer for Lighting.—When the circuits attached to the secondary require current to supply the lamps, it is evident that the only source from which it can indirectly be expected to come is the primary of the transformer. But the electrical energy transmitted to the primary, as has been already shown, is not passed directly into the secondary. Instead it is the means by which the transformer iron is magnetized and demagnetized, and magnetized in the opposite direction. In other words, the magnetism produced in the iron, is the connecting link between the primary and the secondary when the power is either increased or diminished in the secondary. When the secondary, however, requires more current, it is only because the additional circuits connected to it are closed that makes this condition a matter of immediate response to the primary. This coil then permits more electrical energy to pass through it, or to be more explicit, it permits more amperage to enter. But the vital point in the entire process, is one upon which the candle power of the incandescent lamps connected to the circuit of the secondary depends namely, the preservation of the EMF. of the secondary. There is therefore this interlinked system to be considered. First, the readiness of response of the primary to changes of resistance of the secondary, as indicated by multiple lamp circuits being switched in and out. Second, the uniformity of the pressure of the secondary. The fact that a transformer is so constructed that the difference between no load and full load, is the means of causing a perceptible rise and fall in electromotive force of the secondary, is indicative of an absence of harmony in design. The heightened and lowered lamp candle power would be an annoyance only relieved by a reconstruction of the primary, secondary and iron cross-section.

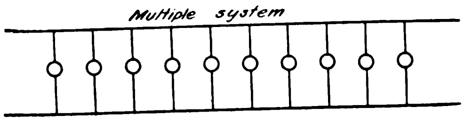


Electricity transformed by means of magnetism.

Constant Current and Constant Potential.—The phrase constant current and constant potential was generally applied to the two great systems of direct current lighting. The constant potential system, has been made the basis of electric lighting by alternating currents as well as direct. In addition a system has been devised, by means of which a constant current is preserved in an alternating circuit as well. The broad classification of constant current and constant potential apparatus, has been the distinguishing feature of the lighting done by such methods. As a general rule, the distinction is made more with reference to the lighting than the power. In this respect it may be added that the use of a constant potential is imperative in all cases where the ordinary incandescent lamp is employed. On the other hand, the arc lamp is the foundation of the division in the electric lighting methods, though both constant current and constant potential lamps are in vogue. The same may be said to a limited extent of the incandescent lamp. There is a method of lighting by incandescents in which the voltage is not preserved, as in all such systems as are in ordinary use. On the contrary, attention is only paid to the preservation of a constant current, and this is the point of similarity between it and a constant current arc lamp system. In either case, the value of the current is limited, the same class of apparatus supplying a constant current to the arc lamp can and has been used to supply a constant current to incandescents. The difference, however, is found in the pressure needed in the two instances for the different lamps. The constant current incandescent, does not require the same voltage as the constant current arc lamp. For instance, in a 1,000 volt circuit of arcs and incandescents, the number of arcs would be, with open globe lamps at least 20; whereas with incandescents the number of lamps would be from 50 to 100.

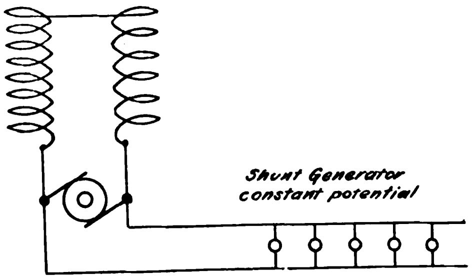


Constant current system.



Constant potential system.

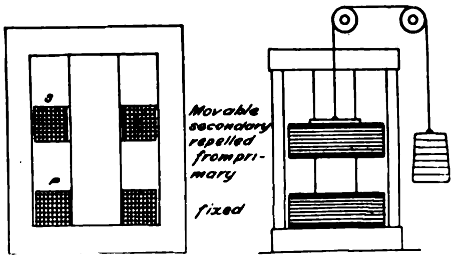
Constant Current Transformers.—In a transformer of this type the ordinary relationship between the electromotive forces of the primary and secondary are not preserved. Instead certain features are introduced for the purpose of sustaining a relationship of which the outcome is a constant current. It is necessary in such a case, however, to preserve a constant electromotive force at the terminals of the primary coil. A system developed with this fundamental idea as a basis, can be best understood as a series system of lighting. In the ordinary transformer, the primary receives a given pressure; the current meets with a certain reactance, and in consequence only an amount of current passes into the primary able to do the work the secondary imposes upon it. But in all such cases, both the primary and secondary coils are in a fixed position. Not only is this true, but the two pressures are fixed in ratio throughout the process. This, however, is the point of difference between the constant potential and the constant current transformer. In the constant current transformer the primary is fixed in position, but the secondary is movable. In addition, the ratio of the two pressures is not preserved as in the former case. This presents the general idea: a transformer with a movable secondary and a ratio of values so crystallized that only the constant current relationship is preserved. The theory underlying this construction is that a high inductance in the primary and secondary coils, but a relatively low mutual induction between them, will be the means of securing constant current in the secondary. Practical features of design dependent upon these ideas, assumed the form of a transformer with a fixed primary as stated, and a movable secondary coil. The core of the secondary, held in common by the primary as well, is long enough to permit the motion of the secondary when necessary. This motion is due to the repulsion which necessarily occurs between inductively related circuits. It is to be expected, as may be discovered by a citation of Lenz's law: That in all cases of electro magnetic induction, the induced currents have such a direction that their reaction tends to stop the motion which produced them. In other words, the coil of the secondary is free to move, and in consequence when the current in it is very strong, the reaction is great and the coil is repelled magnetically. When the current in the



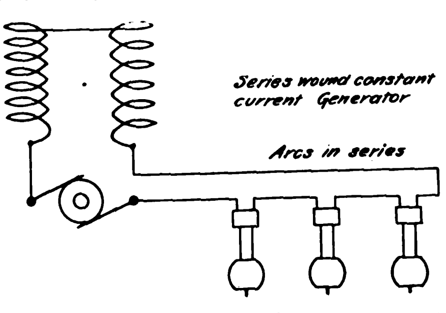
Direct current constant potential system.

secondary is weak the repulsion is not so much in evidence, and in consequence the coils practically rest upon each other. Counterbalancing weights are used, capable of adjustment, by means of which the secondary current is not only preserved at a constant value, but its value may be regulated to represent a certain amount. The degree of repulsion between the coils is not so great that they would of themselves be able to move against great friction. For this reason the two coils are so situated that while one is fixed the other is able to move freely up and down by the aid of a lever and weight system as illustrated. The principle of regulation is readily understood by a consideration of the requirements outside. These are as follows: When a new lamp is added to a series circuit the resistance of the circuit increases. This means less current in the circuit and in consequence less current in the secondary coil. When there is less current in the secondary there is less repulsion between it and the primary coil. In consequence of this the secondary approaches nearer the primary, more current therefore flows through the secondary and more EMF. The effect of this is to repel the secondary to a position where it is able to give to the circuit enough pressure to keep all the lamps burning and enough to fall within the requirements of its being constant. In transformers of the constant current type of large size the primary is composed of two coils, situated above and below. In addition there are two secondaries free to move as in the smaller size, but their movement is both downward and upward respectively. The primaries situated above and below are fixed in position, but the secondaries move in the one case upward to the upper primary, and in the other case downward to the lower primary. In other words, the two secondaries move in opposite directions to each other when the transformer is in operation. This feature has been made use of, to enable the two coils to so affect each other that the regulation for constant current is made without any counterbalancing weights. The series generator for arc lighting is also supplied with automatic means, of an electro-mechanical nature for the preservation of a constant current. But the fact that in one case the current is made constant in a transformer, and in the other case in a generator, naturally calls for a distinct difference between them as pieces of operating mechanism.

Constant Current from a Direct Current Generator.—In a direct current generator, the armature revolves between the poles which produce the magnetic field, and is therefore the source of the EMF. In this respect, the comparison might be instituted of the fields acting in the capacity of a primary, and the armature as a secondary. But this would be only for the purpose of showing that the armature is moved, because unless it is no EMF. can be produced. By this is meant that in the alternating current apparatus, to which reference has been made, the current itself is moving and therefore supplies the basis for inductive action. If the direct current generator were so constructed that its field frame were laminated, then the passage of an alternating current through it would be the means of developing an alternating current in the armature. In this respect the generator becomes a transformer. But it does not belong to that category except in the sense that it is a transformer of a special type, in which mechanical energy is transformed into electrical energy. The electromotive force it generates with a constant speed and constant field is also constant, and it is therefore necessary to introduce means for obtaining a current whose constancy is preserved in spite of the fact that the EMF. under these conditions remains the same. The simple practice of shifting the brushes around on the commutator has been found the best method of accomplishing this purpose. The situation then presents itself of a generator, in which every tendency of the armature to develop a stronger current is met by a movement of the brushes which cuts off the higher EMF. from the circuit at that instant. On the other hand, the tendency of the armature to produce less than the necessary quota of current, is met by a movement of the brushes, which increases the EMF. operating and thus restores the current to its normal value. Both of these processes are necessary when the resistance of the outside circuit increases through the introduction of new lamps, or diminishes when lamps are removed from it.

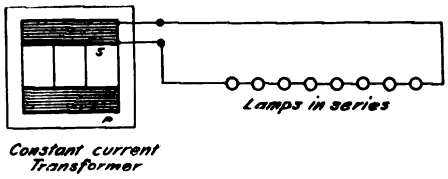


Constant current self-adjusting transformer.



Series system, constant current, direct current system.

Comparison of Constant Current, Constant Potential, Direct and Alternating Current Systems.—The distinguishing features between the various systems employed for supplying arc and incandescent lamps with alternating and direct current can be best understood by a review of the methods involved which may be stated as follows: 1st, Constant potential for incandescent and arc lighting by means of shunt and compound wound generators. Examples of such lighting found in central stations and private installations. 2d, Constant current for arc lighting, generally of high potential and in some scattered instances, of its use for incandescent lighting; the lamps in each case connected in the series. 3d, Constant potential for incandescent lamps and arcs by alternating current. The lamp circuit exactly the same as with direct current, except that the current issues from transformers of various capacities. 4th, Constant current for arc lamps and motors operated by alternating current. In all the cases cited, it must be understood that the electrical energy whether alternating or direct is useful for motors as well. In this respect four classifications also appear, which in a general way cover all applications of electricity to this purpose. 1st, the use of constant potential for shunt, series and differentially wound direct current motors. 2nd, the use of a constant current for series wound direct current motors. 3rd, the use of a constant potential for induction, synchronous and non-synchronous alternating current motors. 4th, the use of a constant current for special constructed motors operated by alternating current. This resume of the situation with respect to light and power is but a brief sketch of the enormous fields each represent in actual practice. The most prominent cases of constant potential systems are found in the use of direct current for street railway work, and arc and incandescent lighting. Constant potential from alternating current



Constant current, alternating system.

mains, is applied in incandescent lighting, and to the running of induction motors of the single, two and three phase type. The recent introduction of the single phase street railway motor is merely an instance of a series wound constant potential motor finding a ready application to a service with a current theoretically well adapted to it, as street railway practice can offer no salient objection to a change in the character of the current as long as the requirements of such practice are fully complied with.

STREET CABLE SYSTEMS.*

BY S. J. WATSON.

(*Concluded from page 332.*)

Wood troughing might be expected to have quite a short life for underground work, but in practice little trouble has been experienced. The materials are inexpensive and easily obtained.

Troughs constructed of stoneware and of cast-iron with wood or porcelain insulators for the cable supports have been used to a considerable extent, a stoneware, or cast-iron covering being provided. Both are suitable materials, although rather rigid, and have given good results.

Another troughing that has been largely used is manufactured of asphalt in lengths of four feet. The joints between lengths are made by means of a hot iron, which renders the material plastic and enables the ends to be formed solid so as to make one continuous length. The cables are laid in the trough and the whole filled up with bitumen. A protective cover of asphalt is then added for protection and ironed down to the sides of the trough. Care should be taken when making the joints between lengths to insure a satisfactory thickness and watertightness of the asphalt so that no moisture can penetrate to the cable which lies on the bottom of the trough without the intervention of bridge pieces. A simple precaution against a bad joint can be made at little expense by inserting a piece of bitumen sheeting about four inches wide between the cable and the trough. This system is reasonable in first cost, the material is flexible, mechanically strong and practically imperishable,

Leaving armored cable out of consideration, it may be said that solid systems are not so convenient to lay in some respects as drawn-in systems. The filling requires the use of a boiler and takes time to melt. Work must be suspended on account of rain to keep moisture out of the trough and avoid the formation of steam bubbles when the bitumen is poured in. A considerable length of street has to be opened out at a time to enable the cables to be laid without frequent joints. Matters such as these do not necessarily increase the cost, but it means additional inconvenience to the public.

CABLES.

For low tension current purposes, whether for a drawn-in or solid system, the cables may be of single, concentric or multicore construction, with hygroscopic or non-hygroscopic insulation, provided with a conducting or non-conducting outer covering.

The first cost of a concentric or multicore system will be less than the equivalent in single cables on account of the greater compactness of the set of cables and the less expensive pipe or trough required when laying. Jointing is, however, much more difficult and costly to carry out, and necessitates the cutting off of the supply while the work is being done.

When such care and attention is given to obtain continuity in the supply, concentric or multicore construction does not appear to offer the minimum of risk, necessitating, as it does, that conductors of opposite polarity will only be separated by an eighth of an inch or slightly more of insulating material, which is invariably paper and particularly susceptible to moisture. Faults are sure to occur sooner or later, and will damage quite a long length of this type of cable, be violent in its results, and probably cut off a portion, if not the whole, of the area supplied.

A more reliable system is obtained by using single cables drawn into separate ways of a conduit or laid spaced apart on a solid system. Each cable is then unaffected by its neighbor's breakdowns.

The most important materials used for insulation are vulcanized rubber, vulcanized bitumen, or bitumen compounds, impregnated fiber and impregnated paper.

Vulcanized rubber is now rarely adopted for street mains, the first cost and the maintenance due to the want of permanence in its insulating properties renders it prohibitive. Could these defects be overcome by manufacturers there is not the slightest doubt it would again come into general use, as high insulation is obtained with a thin coating, which makes the cable of less weight and bulk, and the material is not easily damaged by mechanical means.

The choice is, therefore, between vulcanized bitumen, which does not require an outer watertight covering, and impregnated fiber or paper, which must be provided with a lead or other waterproof protection.

For a solid system no advantage is to be gained by using a lead-covered cable when bitumen non-lead-covered can be obtained at about the same cost.

It is more difficult to choose between lead and bitumen for a draw-in system. Excellent results are obtained with both. Lead-covered have been most successful when drawn into iron pipes, but have given trouble in some instances when used in stoneware, probably due to a deleterious action between the salts used for glazing the stoneware and the lead covering.

The principal defect of all insulation containing a large proportion of bitumen is the liability of the conductors to decentralize on account of the comparatively soft nature of the material. Many faults have undoubtedly arisen from this cause, but manufacturers have given a good deal of attention to the question, and the bitumen now obtainable does not soften at normal temperatures. Isolated cases will, however, occur where, for instance, a cable duct or trough is laid in close proximity to a hot water or steam pipe drain from a house or works to the main sewer in the street.

A leadless cable, whether laid solid or drawn into a conduit of an insulating nature, rarely gives a serious fault without warning even although the insulation is badly damaged, a leakage can consequently be localized and repaired at the most suitable time without inconvenience to consumers.

Much has been said at different times on the question of earthing the lead covering of cables, and it undoubtedly requires treating with caution.

Before the advent of earth return tramway systems no necessity existed for the earthing of all lead coverings and bonding across joint boxes, etc., but owing to the deterioration of the lead in some localities it has now become the general practice to do so. Where long lengths of cable run parallel with the tramway track and are connected direct with the generating or sub-station, it is doubtless a wise precaution to take, but in the event of a fault on the cable developing to a short circuit damage may be done to the covering of all the cables in the immediate vicinity of the fault owing to the relatively poor conductivity of the lead compared with the copper and result in further breakdowns in the near future.

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*Abstract of paper read before the Institution of Electrical Engineers Manchester, Eng., November 28, 1905.

The best method would be to earth at frequent intervals through a fuse with a resistance in parallel as was suggested by a well-known cable company some years ago. If this is done electrolytic action will not take place, and any serious leakage on the cable is reduced to a safe limit. Such an arrangement, although effective, would probably be expensive in first cost and in upkeep.

It is, perhaps, unwise to attempt to forecast what developments in materials for street work may occur, but with present day knowledge it is difficult to see how the cost of underground work can be appreciably reduced in the near future.

The three necessaries are conductors, insulation, and adequate mechanical protection. To substitute any known conductor for copper will increase the bulk and add to the cost of insulation and protection. Higher pressures than those at present allowed on consumers' premises, even if desirable, which is doubtful, would reduce the weight of copper but increase the insulation. The mechanical protection must be provided.

The most encouraging direction for improvement appears to lie in the use of a mechanically strong insulating and absolutely watertight duct or trough, so that bare copper rod or tape can be used, surrounded with a suitable filling. The expense of stranding conductor and of cable insulation, which is at present considerable, will then be saved. The materials at present on the market most suitable for the purpose suggested are the asphalt trough and the patent fibrous material already alluded to as being used for the construction of pipes for drawing-in purposes.

THE MADISON SQUARE ELECTRICAL EXHIBITION.

The first New York annual electric show is now in full swing at the Madison Square Garden, and the exhibits, which are many and varied, cover pretty nearly everything in which electricity can be used, be it the lighting of a coal-oil lamp by a diminutive dry cell, or a wheel of fire by a gigantic oscillator.

A trip around the amphitheatre reveals, of course, many of our old exposition friends and incidentally several new ones, but all are interesting and so arranged that the layman and the technician must rub elbows at every step, for the simple and the complex are placed in alternate booths, and whether this was accidental or planned, it is an excellent idea, for while the former are asking questions the latter are always at hand to answer them.

Among the more novel and recent features of the exhibition may be cited the electric chimes. Everyone is familiar with the grand old Westminster chimes first played by the large clocks in the tower of that famous old abbey, but long since reproduced mechanically by small mantel clocks. The words and music of this chime were composed by Dr. Crotch, in the year 1793; it is known the world over, and when heard never fails to inspire mankind. Now a Maiden Lane firm has applied electricity to the chime clock, and by its application they have succeeded in reproducing the true Westminster chimes, eliminating all the old complicated apparatus, and in consequence bringing it down to a basis where it is compact and simple, and what is especially advantageous it may be operated at any distance from the timepiece proper and mechanically independent of it. Some of the more expensive chimes are fitted with resonators accurately tuned in unison with the bells, giving rich and musical tones and a much greater volume of sound.

Near the center of the auditorium amid the thousands of incandescent lights are a dozen arc lamps that are absolutely new in this country; they are extraordinarily dazzling, developing about 4,000 candle power as against 1,200 candle power of the ordinary arc light, both consuming an equal amount of current. Those are the much talked of Siemens flame arc effect lamps. The lamps produce a golden yellow, a red, or a brilliant white (Edelweiss) light according to the carbons used, which are impregnated with foreign substances. They have created quite a sensation in lighting circles all over the world and are manufactured by the celebrated Siemans concern of Berlin, Germany.

Air-cooled electric drills amaze many of the sightseers who were not familiar with the use of high feed steels. These drills are adaptable to a wide range of usefulness, and as they are portable they can be used wherever drilling or boring is necessary. One of the new types is called a "tri-motor drill," and has embodied in its construction some clever ideas that are of value to the electrical worker. In this drill three motors are located in a single housing and by means of a new winding for the field coils, which insures the running of each and every motor at the same speed; through a unique method of gearing that has been adapted the makers have been enabled to produce the most powerful portable electric drill ever built, and have at the same time kept down the weight to a point where it is not objectionable.

Of the larger devices shown there is a safety electric elevator that is safe, a new block signal system for preventing collisions on electrified roads, a novel car-lighting system operated by the axis of the car when the train is in motion and by an auxiliary storage battery when at rest, while, finally, the Street Cleaning Department of New York City has on exhibition a model of a lighting plant operated by a refuse incinerator. The practical incinerator after which it is patented, is located near the Williamsburg Bridge, and the useful energy generated from the worthless refuse serves to light the great bridge.

Formerly refuse of all kinds was loaded on scows, when these were towed out to sea beyond the three mile limit and then dumped. The garbage cannot be so utilized, but the dry refuse consisting of waste paper and wood from boxes and crates, packing material, etc., and which has heretofore been charged for, by those who had the contract of towing and disposing of it, a certain rate by the cubic yard, is burned, effecting a very material saving The heat thus evolved is used for the generation of electricity, and in this way another saving is effected. From the cars on which it is loaded, the refuse is transferred into great hoppers where it is carried by endless belts to the furnaces below.

The telegraphone for reproducing and recording articulate speech and other audible sounds, the theatrophone connecting different theatres of New York and Brooklyn with the telephone booth at Madison Square Garden, enables 12 or 20 auditors at the latter place to hear what is going on in the former, and the wireless telegraph for sending and receiving messages to incoming and outgoing steamers are prominently in evidence.

An exceedingly pleasing feature is the demonstration of high frequency and high potential currents given in the hall of the first balcony by Prof. Ovington. There are numerous experiments given, and these appeal to all classes of visitors, for those not versed in the technique of the art find enjoyment in being mystified at the strange performance of what they are told is a manifestation of electricity, while those who are acquainted with the underlying principles of the phenomena, find many new and intricate phases of oscillatory discharges to solve. One of Prof. Ovington's displays, perhaps more spectacular than the others, is called the "fountain of fire," and to produce this effect a giant oscillator is set in action to its full capacity. When an enormous amount of energy is radiated into the surrounding ether, great tongues of electric flame blaze upward and bridge the air-gaps between the terminals, while brilliant streamers issue on all sides of the exposed metal parts of the apparatus.

A LONDON 10,000 VOLT THREE-PHASE INSTALLATION.

(From our London Correspondent.)

The big power station of the Charing Cross & City Company at Bow, four miles from the city of London, has been more or less a mystery-box ever since it commenced working. We suppose there is hardly another generating station in London about which electrical engineers have been allowed to know so little. The heavy curtain of secrecy has, however, now been flung aside by the company's own engineer, Mr. W. H. Patchell, who has gratified the natural curiosity of engineers by reading an elaborate account of his station and its equipment before the London Institution of Electrical Engineers, of which he is a vice-president, on December 7th.

The Charing Cross Company built this station for the purpose of supplying energy in the city area in competition with the old-established City of London Co. It already had its works supplying the western district, but when it was allowed to become a rival in the city area, it resolved to equip a big station four miles outside the area of supply—at Bow—from whence it would meet the needs of the city, and at the same time supplement its existing stations in dealing with the western area. The old stations gave a direct current supply, but at Bow a three-phase installation was put down.

In designing his station Mr. Patchell arranged for the highest pressure that could then be directly generated by the machines and used by the motors, as he was anxious to eliminate the complication of static transformers and to save the extra space and switch gear necessitated by them. A 10,000 voltage, and a periodicity of 50 cycles per second were chosen.

The boilers are of the Hornsby "Upright" type, and a novelty in connection with these consists in the arrangement, for the larger boilers, of a grate in the ordinary way at the front, and another at right angles to it, which can be fired from the side. We understand that these second grates have proved to be of enormous benefit when sudden fog or a thunderstorm has called for an extra supply of steam at very short notice. The ashpits of the two grates are quite separate and are provided with the usual doors. At times of light load the boilers are fired from the front only, and the doors in connection with the side grates are all closed. A little dust falls on the bars at the back, which are not otherwise protected, but do not suffer from the high temperature to which they are exposed. As soon as the demand arises coal is thrown on the side grates, the ashpit doors opened, and the extra fires are got away with surprising rapidity. Each boiler has its own McPhail & Simpson superheater.

Economizers are not used so far, because it was decided that, except in times of top load, the large heating surface available in the boilers would render the necessity of such very doubtful; provision, however, has been made for their addition later should they prove desirable.

The generating plant includes two 800 kw. Lahmeyer generators driven by Belliss & Morcom three cylinder, triple-expansion, quick revolution inclosed steam engines, exhausting into jet condensers. There are two 1,600 kw. generators driven by horizontal cross-compound engines by Sulzer of Winterthur; and there are also two 4,000 kw. Lahmeyer generators driven by Sulzer vertical three-cylinder compound engines with the high pressure cylinder in the center and a low pressure on each side. A special feature is the adoption of feed-water heaters on all the engines, inserted between the low pressure cylinder and the jet condenser. The Belliss engines are served by separate condensers driven electrically, while the Sulzer engines each have their own duplicate condensers and drive their own air pumps.

The cooling towers have steel circular shells.

There is a continuous current plant provided to supply the energy required for the generator fields, station lighting, and the various motors about the works. It consists of two Belliss three cylinder triple expansion quick revolution engines driving 300 kw. Lahmeyer continuous current 200 volt dynamos; also two 350 kw. motor generators and a Hart storage battery.

Mr. Patchell says that no difficulty whatever has been experienced in paralleling the 800 kw. machines driven by high-speed engines, with the larger machines driven by slow-speed engines.

The 4,000 kw. generators have a fly wheel diameter, over poles, of 25 feet; there are 72 poles; the total weight of each machine is 197 tons; the outside diameter of stator frame is 29 feet 2 inches, and the speed 83.3 revolutions per minute.

The switchboard is arranged in two distinct halves, which may be connected by an emergency switch. The board is practically a three-decker. The resistances for the fields of the machines stand on the main engine-room floor underneath the principal switchboard gallery. The panels carrying the controlling gear are upon the principal gallery. The high tension switches are placed on the upper gallery, and are worked positively from the principal gallery by levers.

Cable-charging gear is provided in the shape of a small motor generator and two transformers with suitable connections, so that it may be used either to run up the cables to working pressure or to test them at 15,000 volts. A three-phase generator is driven by a direct current motor, and produces current at a normal 2,000 volts pressure. The current is then stepped up by a bank of two three-phase oil-transformers, and the pressure is varied by varying the field of the 2,000 volt generator. Special bars and switches are provided in connection with the charging gear, so that a cable may be run up and then put in parallel with other working cables, or a working cable may be taken off the main bars and discharged for testing or other purposes.

At present ten trunk feeder mains leave the Bow generating station; they are all three-core, lead-sheathed, paper cables. Six go to the city area and four to the West End, but means for interconnecting them are provided in the city. The cables are laid on the solid system in steel troughs which are heavily bonded to meet the requirements of the Board of Trade.

There are four sub-stations in the city, each having a motor-generator and battery plant. The Fenchurch Street sub-station is typical, and its buildings are erected for accommodating motor-generator plant of 8,400 kw. capacity, and battery plant of 1,600 kw. on a four-hour rating.

The distributors and feeders in the two districts are paper insulated, lead-covered cables laid on the solid system. Each feeder is provided with an automatic cut-out in the sub-station and the distributing networks supplied by separate feeders are interconnected through inclosed type fuses.

New York Electrical Society.

The 255th meeting of the Society will be held at the American Institute, 19 West 44th street this (Wednesday) evening, December 20, at 8 o'clock.

Mr. J. M. Waldron, the signal engineer of the Interborough Rapid Transit Company, will deliver a lecture on "The Signal System of the New York Subway."

In view of the magnitude of the underground railway system of New York, the density of the passenger traffic, the frequency of the trains and the very high speed maintained, the importance of the subject appeals to every one interested in the problem of transportation and in the distribution of the population of large cities. Mr. Waldron will discuss why it was necessary to install a block signaling system; the selection of a system; the power distribution; the alternating current track circuit; the alternating current relay; the mechanism of the signal; the automatic train stop; the air supply and distribution; the interlocking plants, and the practical operation of the system.

Gift to Princeton.

By the will of Dr. J. S. Sayre, which the Missouri Supreme Court has declared valid, $40,000 has been made available for the endowment of fellowships in applied chemistry and electricity to Princeton College.

Copper Prices.

The Boston "Engineering and Mining Journal" appears to have revised its copper prices. It now quotes the metal at 18¾ cents for both lake and electrolytic. Its average price for the metal for the month of December will be watched with interest, for that will be the price which the Old Dominion, Shannon, United Copper and Granby companies will receive for all copper sold this month.

Four Street Railway Systems to be Incorporated.

Pittsburg and Washington, Pa., capitalists will on January 3 make application for charters for four street railway systems, which, it is intended, will connect towns along the Monongahela River with Wellsburg, on the Ohio River. The four companies are to be known as the Coal Center Electric Company, the West Middletown Electric Railway Company, the Washington & Brownsville Street Railway Company, and the Independence Street Railway Company. The companies will be incorporated with only nominal capital, but later on it will be increased to $500,000 each.

Big Electric Contract Let.

A Pittsburg dispatch to the New York "Tribune" says: "The General Electric Company has obtained the contract for equipping the Atlantic City branch of the Pennsylvania Railroad to be operated by electricity. The Westinghouse interests refused to enter into competition with the General Electric at the price named by the New York company. The Westinghouse interests permitted the contract to go by default, and it is figured that at the price of material and labor the General Electric Company stands to lose about $1,500,000, according to the experts of Western Pennsylvania. The contract is for $3,000,000."

Editor of the Question Box.

President Blood has appointed Mr. Paul Lupke, superintendent of the Trenton Division of the Public Service Corporation of New Jersey, editor of the Question Box for the twenty-ninth convention of the Electric Light Association, to be held next May or June. Mr. Lupke has been from the first one of the most enthusiastic and close students of the Question Box, and is a firm believer in its value to central stations. He is himself a thorough engineer, and will undoubtedly make this year's Question Box the equal, at least, of its predecessors.

Hartford Electrical Society Election.

The Hartford (Conn.) Electrical Society, at its recent semi-annual meeting, elected the following officers:

President—Prof. Henry A. Perkins.
Vice-President—Charles A. Hovey.
Recording Secretary—A. G. Steele.
Financial Secretary—S. W. Harney.
Treasurer—Frederick C. Hedrick.
Lecturer—T. H. Day.

"Electric Light and Power Economics," will be the subject of a lecture by Prof. Perkins before the Society tomorrow evening, December 21.

Keystone Telephone Certificates Listed.

There has been listed $2,750,000 of the Keystone Telephone Company engraved stock trust certificates, issued against a like amount of common stock of the company deposited with the Union Trust Company under the terms of the trust agreement of July 1, 1905. These certificates are countersigned and registered by the Provident Life & Trust Company and are transferable at the office of the Union Trust Company, Philadelphia, agent for the voting trustees.

ELECTRICAL PATENT RECORD

LETTERS PATENT ISSUED DEC. 12, 1905.

Electric Railways and Appliances.

806,867. Trolley-Contact. Ira J. Bradshaw, Waukegan, Ill., assignor of one-half to Jacob J. Dietmeyer, same place. Filed Sept. 1, 1905.

807,029. System of Electric Railways. Joseph H. Hoadley, New York City. Filed Sept. 16, 1904.

807,089. Electrically-Driven Suspended Railway. Rudolf Pfaffenbach, Leipsic, and Hermann Muller, Leipsic-Gohlis, Germany. Filed Jan 13, 1904.

807,152. Car-Fender. Eli Campanari, New York City. Filed Aug. 11, 1905,

807,199. Magnet-Controlled Third-Rail System. Henry J. Palmer, Philadelphia, Pa., assignor of one-half to Max Bielman, New York City. Filed Oct. 3, 1904.

Electrical Machinery and Apparatus.

806,777. Controlling Means for Electric Motors. Chas. M. Clark, South Orange, N. J. Filed July 7, 1903.

806,782. Magnetic Clutch. George A. Damon, Chicago, Ill., assignor to the Arnold Magnetic Clutch Company, Milwaukee, Wis. Filed Feb 21, 1903. Renewed Dec. 7, 1903.

806,789. Joint for Electric Conductors. Austin Fleeger, Chicora, Pa. Filed May 3, 1905.

806,942. Electric Time-Lock. John T. Van Dillen, St. Louis, Mo. Filed Aug. 17, 1904.

807,017. Electric Time-Switch. Milton T. Campbell Indianapolis, Ind., assignor of one-half to John C. Ertel, same place. Filed June 5, 1905.

807,051. Electric Attachment Plug. Frederick F. Strong, Boston, Mass. Filed April 3, 1905.

807,053. Switch-Signal. John C. Wigman, Greenbay, Wis. Filed April 6, 1905.

807.263. Junction-Box for Electrical Conductors. Edwin T. Greenfield, Monticello, N. Y. Filed June 21, 1904

807,270. Thermal Cut-out for Electric Conductors. Bryson D. Horton, Detroit, Mich., assignor to the Horton-Morehouse Company, same place. Filed March 13, 1905.

807,390. Radiator and Coil. John H. Lindsay, New York City, assignor of one-half to Frank Dobson, same place. Filed March 19, 1904.

Telephones and Telephone Apparatus

806,790. Telephone Bracket. Henry F. Foersterling, St. Louis, Mo. Filed March 6, 1905.

806,950. Selective System for Party-Line Telephones. William M. Bruce, Jr., Springfield, O., assignor of one-third to James S. Bratley, Jr., Wauseon, O., and one-third to Charles D. Juvenal, Springfield, O. Filed April 3, 1905.

807,235. Alarm and Telephone System. Garrison Babcock. Chicago, Ill. Filed Dec. 14, 1903.

807,316. Telephone System. Robert H. Polk, Birmingham, Ala. Filed Jan. 19, 1904.

Miscellaneous.

806,769. Adjustable Support for Telegraph Line Wires. Jasper N. Bell, Stratford, Ia. Filed Dec. 23, 1904.

806,801. Telegraph Repeater. Oscar C. Greene, St. Paul, Minn., and Charles H. Gaunt, Topeka, Kan. Filed April 28, 1902.

806,853. Manufacture of Vapor Electric Apparatus. Percy H. Thomas, East Orange, N. J., assignor to the Cooper Hewitt Electric Company, New York City. Filed Feb. 12, 1904,

806,894. Telegraphic Repeater. Stephen D. Field, Stockbridge, Mass., assignor to John J. Ghegan, Newark, N. J. Filed Dec. 31, 1904.

806,887. Insulator-Pin. Walter T. Goddard, Victor, N. Y., assignor to the Locke Insulator Manufacturing Company, Victor, N. Y. Filed May 24, 1905.

800,891. Telegraphic Apparatus. Melville A. Hawley and William L. Rhoads, St. Louis, Mo.; said Rhoads assignor to said Hawley. Filed April 3, 1905.

806,935. Insulating Wire-Support. John A. Sullivan, Cleveland, O., assignor of one-half to I. F. Helper, same place. Filed Dec. 15, 1904.

806,953. Electric Signaling Apparatus. Louis A. Codere and Alphonse E. Croquette, Sherbrooke, Can. Filed Nov. 25, 1904.

806,966. Wireless Telegraph System. Lee De Forest, New York City. Filed Jan. 25. 1904. Renewed Oct. 14. 1905.

807 307. Insulator. Louis McCarthy, Boston, Mass. Filed Feb. 18, 1904.

THE TELEPHONE WORLD.

Meeting of West Virginia Independents.

At a recent meeting of the executive committee of the Independent Telephone Association of West Virginia, held in the office of W. C. Handlan, manager of the National Telephone Company in Wheeling, it was decided to hold the first meeting of the association at the Chancellor Hotel of Parkersburg, on February 22 and 23, 1906, at which time the representatives of all the Independent telephone companies of the State and also from other States will be in attendance.

The object of the coming meeting is to bring all of these who do not now belong to the association into it and bring harmony among the Independents so that all may fight in harmony in the battle against the competing company.

The executive committee members at the meeting were General Manager A. E. Davis, of the West Virginia Telephone Company of Parkersburg; J. Walter Barnes, general manager of the Consolidated Telephone Company of Fairmont, and W. C. Handlan, of the National Telephone Company of Wheeling.

The St. Joseph Valley Telephone Company was lately formed to do business in Elkhart, La Porte, St. Joseph, La Grange, Steuben, Noble, Kosciusko, Marshall and Starke Counties, Ind., with main offices at South Bend. Its capital stock is $25,000. The directors are: Theodore Thorward and Jerry Donovan, of South Bend, and Martin E. Crow, of Elkhart.

The Southern New England Telephone Company is to build a new exchange in Danbury, Conn., which will be equipped with the common battery system.

The Mt. Zion, Mo., Telephone Company is a new concern incorporated by J. D. Snyder, J. W. Stanton, T. H. Good, J. N. Butler, E. P. Edwards, T. J. Bilderlack and others.

To give better service and cheaper rates to residents of Solvay, Baldwinsville, Skaneateles and East Syracuse, branch exchanges are soon to be established in those villages by the Central New York Telephone & Telegraph Company.

The Delaware & Atlantic Telegraph & Telephone Company has decided to extend its underground system and has made application to the street and sewer Department to lay conduits in Wilmington.

The Central Telephone & Electric Company of St. Louis, Mo., lately filed a statement to show that it had made an increase in its capital stock from $50,000 to $75.000, all the increase paid. Assets, $105,736.07; liabilities, $25,836.07.

A new company, known as the Courtland Emporia Telephone Company, capitalized at $5,000, has been incorporated in Drewryville, Va., with D. B. Drewry, president, and F. P. Pope, secretary and treasurer.

The Farmington Valley Telephone Company of New Britain, Conn., lately filed a certificate with the State Secretary, certifying to an increase in capital stock from $27,000 to $54,000.

Independents Open New Territory.

New telephone territory is rapidly being opened to Galesburg, Ill., by reason of the expanse of the Independent companies in that section of the State. A short time ago the line between Macomb and Monmouth was opened; soon the new Williamsfield line will be in operation, and it is now but a matter of crossing the Mississippi River when the new Burlington line will be ready for use.

The line between Macomb and Monmouth covers a gap in the network of long distance lines being planned by the Independents and now gives Galesburg excellent service to Macomb as well as intermediate points. The Independent company in Galesburg has been able to reach Macomb before, but the service has not been nearly as satisfactory as it is at present.

The new Williamsfield line will also fill a long felt want. Williamsfield has been on the line heretofore, but the service has been slow and also poor. Now a Williamsfield company is building a trunk line from there to Knoxville, with which Galesburg will be connected and form a trunk line from Galesburg to Williamsfield.

The poles for this line are already being erected and within two weeks the wire will be stretched for the entire distance of 15 miles and the line opened. It will be a trunk line between those places with no intervening station.

When these lines are completed and in running order considerable new telephone territory will be opened to the people, which will be heartily appreciated.

Telephone Merger Under Way.

It is understood that the Keystone Telephone Company, of Philadelphia, Pa., is negotiating for the control of the Eastern Telephone Company, which controls the system in Camden and Gloucester, N. J., has an interest in the Camden & Atlantic City, and owns 40 per cent. in another paying property. If the deal goes through it is said that the Keystone will have control of the territory.

The Inter-county Telephone Company, a new Independent telephone company, of Decatur, Ala., according to a dispatch, has completed its system of lines and is now about ready for business. This company will cover the eastern part of the county, which has never had any telephones. The company will also connect with Huntsville. The capital stock of the company is $20,000, and the officers are: President, C. E. Hodgeboom; vice-president, Gus May; secretary, C. D. Hodgeboom.

James A. Boyd and Charles A. Boyd, of Cambridge City, Ind., owners of the Independent Telephone Exchange there, have purchased the Hagerstown Independent telephone plant. Nearly 2,000 'phones are on the system, which extends from Losantiville on the north to Connersville on the south.

The Pioneer Telephone Company has purchased the automatic system in Waukomis, Okla., and will make a number of improvements in the local exchange.

Another Independent Company Launched.

Another effort is being made to float an Independent telephone company, which will have its headquarters in this city, and will operate throughout the country. In its prospectus the Great Eastern Telephone Company, as the most recent Independent telephone company is called, offers 50,000 shares of preferred 6 per cent. cumulative preferred stock at par, with which a bonus of 50 shares of common stock will be given for every 100 shares of preferred stock bought.

George R. Bidwell, former Collector of the Port, is one of the directors. He said recently that the Great Eastern Telephone Company was in no way identified with the Finucane telephone enterprise, which sought to raise $15,000,000 by an issue of bonds.

The Great Eastern Telephone Company is said to be a holding company of several Independent concerns. It holds a franchise for a telephone system in New York granted in 1883 to the New York Electric Lines Company, and quotations from the franchise are given. The company also asserts its ownership to a franchise in Brooklyn. Among the other directors are J. F. O. Meyers, J. Van Vechten Olcott, W. C. Adams, George C. Edwards, Edward G. Ward and William H. Stayton.

A deal has recently been consummated by the Independent Union Telephone Company of Albany, N. Y., whereby it secures possession of the Independent telephone company of Herkimer County, which operated a rural line out of the village of Herkimer. The system transferred to the Albany company is located in the towns of Herkimer, German Flatts and Little Falls, and is connected with the Herkimer telephone system. The line extends from that village to the south side of the Mohawk River, thence to Fort Herkimer and Jacksonburg, thence to the north side of the river and eastward. The consideration was said to have been $1,725.

Three telephone companies are struggling for a franchise in Brantford, Ont. The Bell Company desires to hold what it has, an exclusive franchise. The Canadian Machine Company and the Ontario Telephone Company are looking for competitive franchises. The Canadian Machine Company desires a 21 years' agreement, with an option for municipal ownership; prices to be $25 for business and $15 for residence 'phones, and the Ontario company wants a 20 years' franchise at $25 for business and $18 for residence.

James M. Brogan, of Dansville, N.Y., has been appointed by the officials of the Inter-Ocean Telephone Company to manage the affairs of the company in that village.

Many additional telephones have been installed in Wilmington, Del., during the past few months and it is said that there is now a telephone for every 15 inhabitants.

The Quincy, Ill., Long Distance Telephone Company, capitalized at $2,000, has been incorporated by Frank J. Penick, J. R. Pearce and Samuel E. Scott.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Anadarko, Okla.—This city is considering the advisability of voting $5,000 additional bonds for the extension of the electric light service.

Ashland, Ore.—The Ashland Electric Light Company has made a proposition to sell its entire holdings here, including the water rights which the company claims, now in litigation, and also a 20-year lease which it holds with the Condor Power Company, which now supplies the current to the city. The company asks about $60,000. If its proposal is accepted all suits will be dropped and it will withdraw from the city.

Belleville, Kan.—At a recent meeting of the citizens, it was the expression of those present that the city erect a $20,000 electric plant, and run it in connection with the waterworks. There is a company organized here, whose purpose is to erect an electric light plant, and it may be possible that the company and the city council will work together.

East Moline, Ill.—An ordinance was lately submitted to the council by the Central Electric Company providing for a franchise to install a light and power plant in this town, to be in operation in six months. A. A. Woodworth represents the company.

Edgefield, S. C.—At a recent mass meeting, held to discuss the light and water problem, a committee was appointed to get in touch with the principal and best installers of water and electric plant systems. Among the men interested are J. C. Sheppard, A. E. Padgett, Charles E, May, M. P. Wells, W. W. Adams, J. W. Thurmond, J. L. Mims, B. B. Jones, J. M. Cobb and Thomas H. Rainsford.

Eldora, Ia.—John Rath, one of Ackley's most influential and wealthy citizens, has offered his home town the gift of an electric light plant, worth about $15,000, fully equipped and ready for business.

Fredericksburg, Tex.—G. A. Pfell will erect an electric light plant in connection with his cotton gin.

Homestead, Pa.—A newly organized concern, known as the Homestead Light & Power Company with a capitalization of $100,000, has asked for a franchise here. A committee has been formed to procure estimates of the cost of construction and maintenance of an electric light plant.

Laramie, Wyo.—The Union Pacific will install its own electric light plant in the depots, yards, shops and steel mills.

Millersburg, Ia.—The Fairbanks & Morse Electric Company of Chicago, is preparing to put in an electric light plant here.

Montgomery, Ind.—C. W. Slibhard is preparing to erect a new electric lighting plant here.

Port Townsend, Wash.—John Siebenbaum and others have been granted a franchise by the city council to construct an electric light plant, erect poles, string wires and do any and all things necessary to properly operate such a plant.

Richmond, Ind.—At a meeting of the city council last week action was taken toward increasing the capacity of the municipal lighting and power plant. The council has instructed the board to employ an electrical engineer to draw up plans and specifications for the addition of another unit to the plant,

Rutland, Vt.—The electric light plant of this city was recently damaged by fire to the extent of about $5,000.

Salt Lake City, Utah.—Frank Taylor, of this city, has filed an application with the State engineer for 200 feet of water from the Weber River in Summit County, to be used for furnishing electric lighting and power in Oakley.

Savannah, Ga.—This city will probably have a political fight for the control of the electric lighting contract of the city next year that will be like that in Atlanta some years ago. The Savannah Electric Company, which now has the contract for the city lighting, is to be opposed by the Savannah Lighting Company, a new concern. Both sides are said to be getting ready for a battle at the polls next year.

St. Matthews, S. C.—An election will soon be held to vote on the proposed issue of $20,000 of waterworks and electric light bonds.

Syracuse, N. Y.—The Syracuse Electric Light Company has been incorporated with a capital of $100,000. The incorporators are W. Darrone, C. E. Darrone and others.

Tallapoosa, Ga.—This city has voted a $10,000 bond issue for the erection of a new electric light plant.

Victoria, Tex.—The citizens have petitioned the council for an electric light plant.

STREET RAILWAYS.

Auburn, N. Y.—The Mohawk Valley Company, the trolley company of the New York Central Railroad, is preparing plans for the electrical equipment of the Auburn branch from Syracuse to Rochester, utilizing the Rochester & Eastern as far as possible.

Canton, Ill.—Construction of at least one section of the Illinois Central Electric Railroad Company's line will be begun next spring, if the present plans of the board of directors are carried out.

Carmel, Ind.—A company was incorporated at Indianapolis last week to build a traction line from this city to Frankfort through Westfield and Sheridan.

Charter Oak, Ia.—P. F. Piene is in communication with parties who propose to construct a trolley line from Council Bluffs to this place.

Columbus, O.—D. Hood, of this city, is in charge of the preliminary surveys of the Ohio Central Traction Company, which expects to build an electric line from this city to New Lexington.

Greenville, Pa.—Cox Brothers, former citizens of this place, have projected plans to build an electric railway from Ashville to this city.

Magnolia, Ia.—An electric railway is to be built from Missouri Valley to this place. The work of securing the right of way will be commenced at once. The road will tap an exceedingly rich farming country which has no nearby railway outlet. The project is backed by Harrison County capitalists.

Milwaukee, Wis.—The Milwaukee Electric Railway Company is to spend a large sum of money on its system. It will erect a new power station and build two new cross town lines.

Mt. Vernon, O.—A franchise was recently granted the Mt. Vernon Electric Street Railway Company to extend its line into South Vernon.

Ottumwa, Ia.—H. M. Byllesby & Co., of Chicago, lately purchased the stock of the Ottumwa Traction & Light Company, and will make large extensions and improvements.

Syracuse, N. Y.—The feed wire which supplies electricity for the operation of the Solvay line of the Rapid Transit Railway is to be extended for a distance of ¾ of a mile in order to furnish more power at the western end of the road.

POWER PLANTS.

Georgetown, Col.—Upper Clear Creek will soon have another electric power plant, capable of supplying an abundance of power W. E. Renshaw, of Idaho Springs, has entered the field, and expects soon to be in a position to furnish power for mines.

San Bernardino, Cal.—The Hill street power plant of the San Bernardino Electric Company has lately been destroyed by fire, entailing a loss of $65,000.

BIDS WANTED.

Cape Girardeau, Mo.—The Cape Brewery & Ice Company will need electrical equipment.

Elbow Lake, Minn.—Sealed proposals will be received by J. S. Arneson, county auditor, until January 4, 1906, for the furnishing of electric light fixtures for the new Grant County Courthouse. Bids must be accompanied by a certified check in the sum of $100, as an evidence of good faith.

Freeport, Ill.—Sealed bids will be received by the city clerk until 3 o'clock January 2 for lighting this city for a term of five years.

Grand Island, Neb.—The city council will receive bids for electrically lighting this city for a term of one year.

Marshall, Mo.—William H. Black, president of the Misouri Valley College, wants prices on electrical equipment.

Washington, D. C.—The Navy Department through the Bureau of Supplies and Accounts is inviting sealed proposals until January 2, 1906, for furnishing the following electrical material embraced in schedule 286: League Isand Navy Yard, 3,500 incandescent lamps, 5 annunciators, 11,000 feet wire, 6,000 feet lighting wire, 15,000 feet lighting wire, twin conductor; New York Navy Yard, 3,000 feet lighting wire, about 1,000 pounds magnet wire, 550 pounds insulating tape, 50 water-tight bells, 25,000 fuses, 10,000 feet lamp cord, 10 testing generators, 10 voltmeters, 5 sets of engine indicators, 1,000 attachment plugs, 30 telephone headgears and miscellaneous electric supplies. Proposal blanks and detailed information can be obtained on application to the Bureau or to the Navy Pay Office in New York. On January 9 the Bureau will open bids for furnishing the New Orleans naval station with weather-proof wire and electrical supplies, embraced in schedule 290, which can be obtained upon application to the Bureau.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 18½@18⅞c. Lake 18½@18⅞c.; casting, 18@18½c.

The Reading (Pa.) Traction Company has declared a dividend of 75 cents a share, payable January 1.

The annual meeting of the stockholders of the El Paso (Tex.) Electric Company will be held in East Orange, N. J., on January 8.

A Philadelphia Electric director is quoted as saying that the company is earning 7½ per cent. on its capital stock of $10,000,000.

The American Telephone & Telegraph Company's stockholders will meet to-morrow to authorize the issue of $150,000,000 of convertible bonds.

The Brooklyn Rapid Transit Company has applied to the New York Stock Exchange to list $3,042,000 additional first refunding mortgage 4 per cent. bonds of 2002.

The stockholders of the Toledo Railways & Light Company will hold their annual meeting in Toledo, O., on January 18. Books close January 6 and reopen January 19.

Westinghouse interests say that the increase of capital of $4,000,000, to be voted December 23, will be used mainly to build and equip shops needed to increase the output of turbines.

The trustees of the Boston & Worcester Electric Companies have declared a regular semi-annual dividend of $2 per share on the preferred stock, payable January 1 to stockholders of record December 23. Transfer books close December 24 to January 1.

The Boston Stock Exchange has stricken from the unlisted sheet the temporary receipts for stock of the Mexican Telephone Company and has placed on the list 21,190 shares of common and 10,959 shares of preferred stock of the Mexican Telephone & Telegraph Company.

Wall Street is now anticipating a fight between E. H. Harriman and Thomas F. Ryan, which may involve, through the Legislature, the Consolidated Gas Company and the Metropolitan Street Railway Company of New York, in which Mr. Ryan is largely interested.

William A. Read & Co. of New York are offering to investors 1,000 shares of Twin City Rapid Transit Company 7 per cent. cumulative preferred stock to net the investor 4⅝ per cent. This company controls and operates all the electric railways of Minneapolis and St. Paul, and suburban points, in all 325 miles.

S. C. Schenck, of Toledo, O., a heavy stockholder in the Toledo & Indiana Electric Railroad, says that bonds of the road aggregating $1,600,000 have been refused by the New York underwriters and thrown back on the promoters. The cause of the rejection is alleged to be faulty construction of the road.

A circular will be issued to the stockholders of the preferred stock of the Bullock Electric Manufacturing Company within a short time announcing a change in the financial arrangement. Under the present lease of the Bullock Company to the Allis-Chalmers Company the preferred stock is guaranteed for 25 years. Under the new arrangement the Allis-Chalmers Company perpetually guarantees the stock. The issue amounts to about $1,200,000 and is a 6 per cent. cumulative stock. The present certificates will be recalled and new ones issued.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS. Name.	Closing price Dec. 18
New York City.	
Broadway and Seventh Avenue	243½
Interborough Rapid Transit	211
Manhattan Elevated Railway	161½
Metropolitan Street Railway	120¾
Metropolitan Securities	76¼
Ninth Avenue	195
Third Avenue	125
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	88⅛
Brooklyn City Railway	243
New Orleans Railway	89
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	83
Philadelphia Traction	100⅞
Union Traction	62½
Boston.	
Boston Elevated	153
Massachusetts Electric Companies, com	15¾
do. do. do. pref	60½
West End Street, com	98
do. do. do pref	113½
Chicago.	
City Railway	205
North Chicago	85
Union Traction, com	12
do. do. pref.	40½
ELECTRIC MANUFACTURING COMPANIES' STOCKS.	
New York City.	
Allis-Chalmers, com	20⅝
do. pref.	61
Electric Boat, com	80
do. do. pref.	70
Electric Vehicle, com	15
do. do. pref.	20
Westinghouse, com	175
do. pref.	190½
General Electric	175¾
Boston.	
Edison Electric Illuminating	239
General Electric	183⅝
Westinghouse Electric & Mfg., com	85½
do. do. do. pref.	100
Chicago.	
Chicago Edison	163
National Carbon, com	76½
do. do. pref.	116
Philadelphia.	
Electric Company of America	11¼
Electric Storage Battery, com	81
do. do. do. pref.	81
TELEPHONE AND TELEGRAPH STOCKS.	
Boston.	
American Telephone & Telegraph Company	135
Western Telephone Company	13¼
New England Telephone Company	184
New York.	
American Telegraph & Cable Company	90
Commercial Cable Company	210¼
Mexican Telephone Company	1⅝
New York & New Jersey Telephone Company	160
Postal Telegraph Cable Company	..
Western Union Telegraph Company	93¼
Chicago Telephone Company	138½
MISCELLANEOUS STOCKS.	
Chicago Subway	47½
Otis Elevator Company	60
Standard Underground Cable	..
Twin City Rapid Transit	117¼

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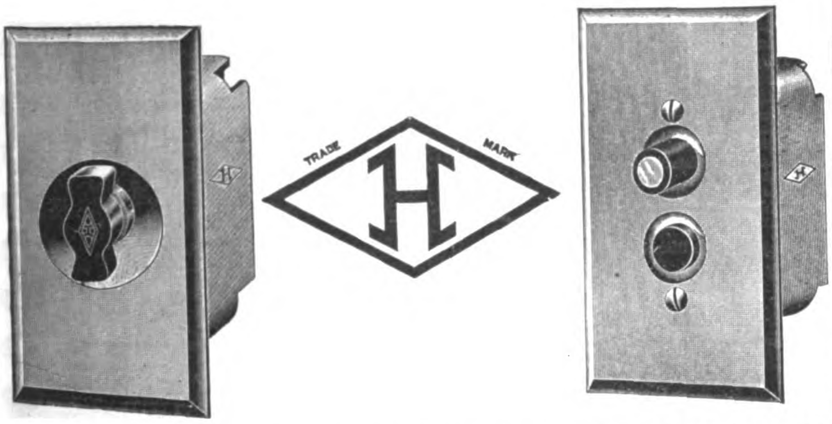

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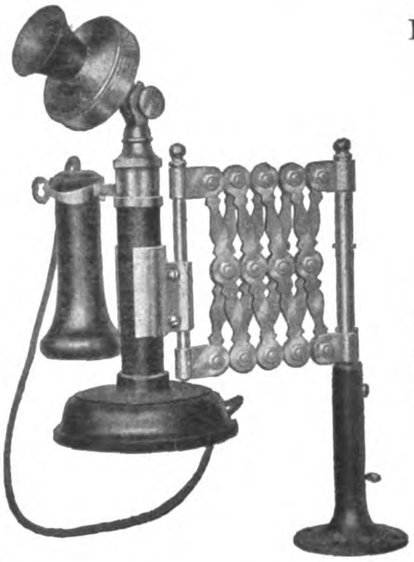

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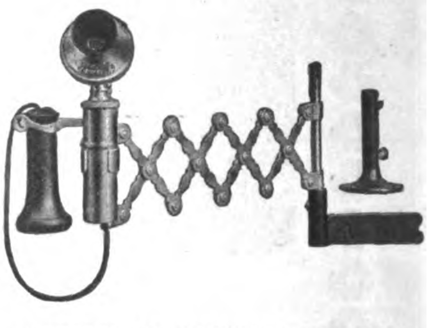

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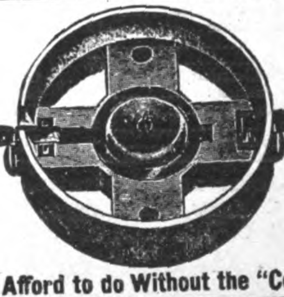
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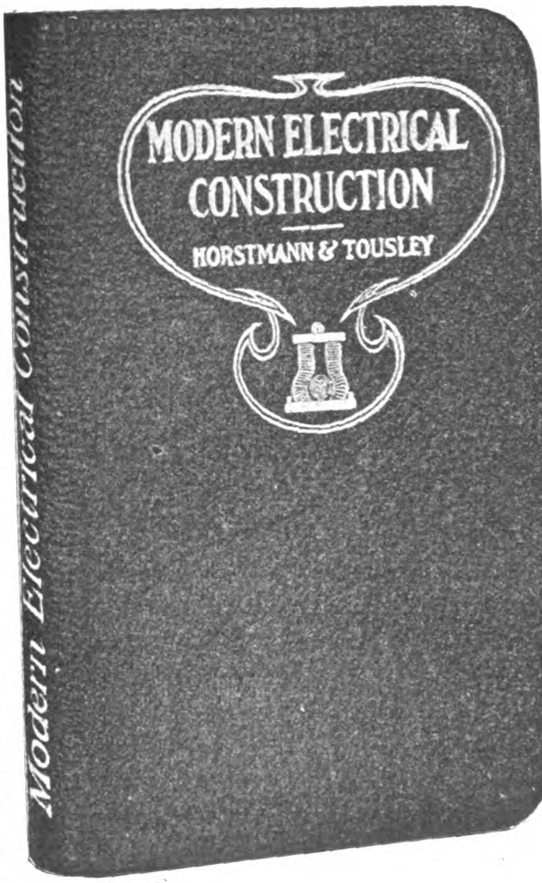
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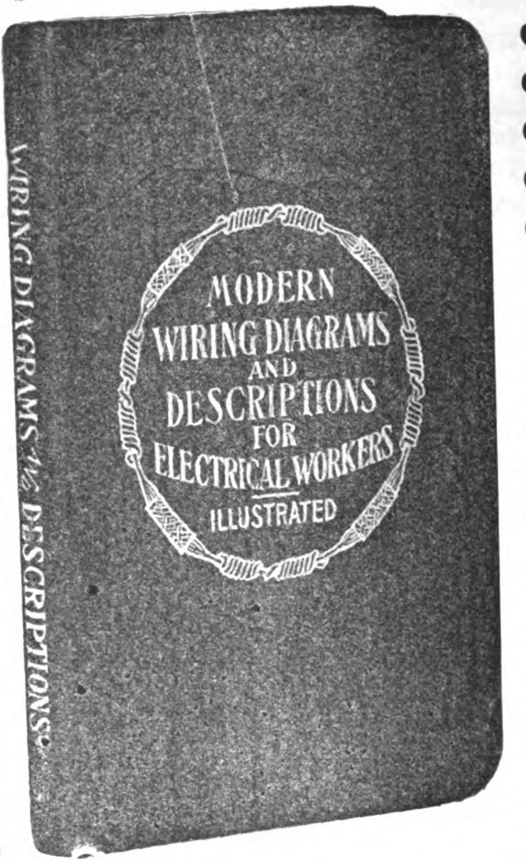
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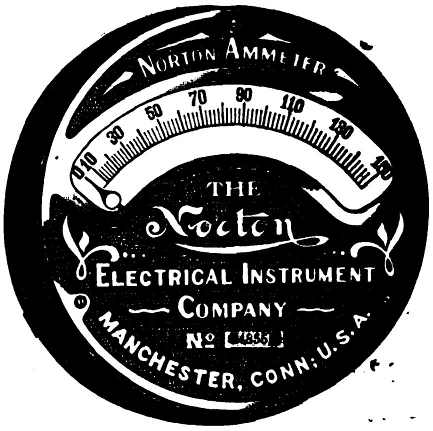
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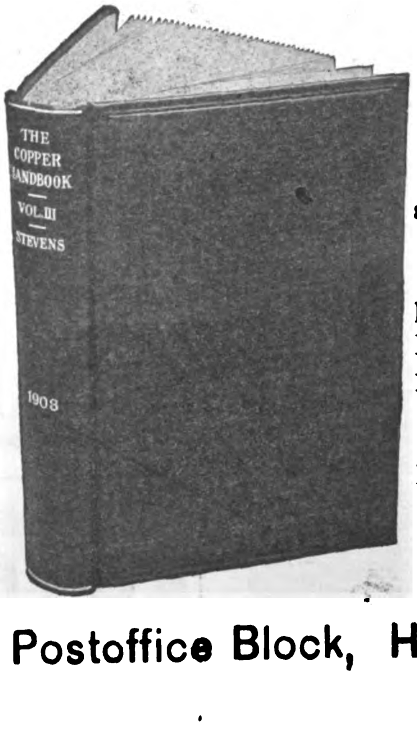
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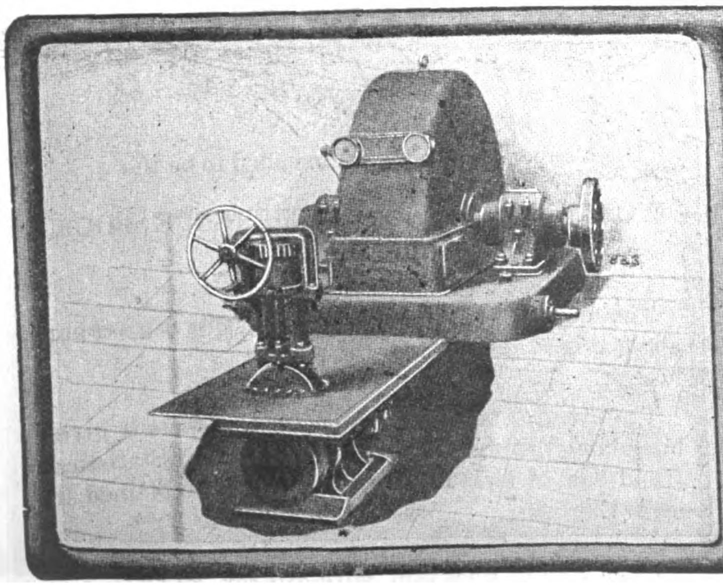

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VOL. XXIX. NEW YORK, DECEMBER 27, 1905. NO. 26.

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EDITORIAL NOTES.

The Year That is Going and the Year That is Coming.

It cannot be denied but that the year about to close has been a prosperous one generally speaking to the electrical fraternity. Business throughout the country in almost every line has been—if not booming—in an exceedingly healthy condition, and as a natural result the electrical manufacturers have gotten their share.

During the year 1905 the war in the Far East has been terminated, which means among other things the opening up in the near future of markets heretofore but little exploited. Japan has been for some time a good customer for electrical machinery, and there is but little doubt but what China will eventually need electrical apparatus, and there is no good reason why it should not be purchased in this country, providing our manufacturers and dealers seek that market in the proper way.

Looking forward, the year 1906 would seem to harbor no commercial cloud of adversity in spite of the unsatisfactory condition of affairs in Russia. In a country such as ours, prosperity or business depression does not depend upon the internal doings of a nation thousands of miles away.

* * *

Objection to Searchlights on Trolley Cars.

Interurban lines, and those denominated as cross-country lines, often have routes to cover which introduce a decided element of danger through the possibility of collisions or worse. The oil lamp, originally employed as a headlight, gave way to the incandescent lamp. The light from this was not strong, neither was it very far reaching When the arc lamp attained that degree of excellence which made its mechanism a familiar thing to manufacturers, a successful effort was made to adapt it to moving vehicles, such as locomotives and electric cars. In both these instances its adaptation proved an unqualified success.

The steam locomotive, with its powerful space annihilating beam could light its way a thousand or more feet in advance. The sense of security this gives to engineers can be readily appreciated, when it is remembered that a feeling of apprehension is never absent from those fully alive to the responsibilities of their position. In fact this is the only menace to safe travel—the darkness of the track. The train plunging ahead from darkness into darkness, gives the engineer but a momentary glimpse of the track. We give more in lives and money each year, as a tribute to the moloch of railroads, than was ever required by the bloodiest battles of the civil war. This is true as well of the electric traction companies operating within and beyond the city limits. In many cities the damages paid through loss of life and bodily injuries represent yearly sums that range from a million dollars to hundreds of thousands in the said cities respectively.

When we hear of any objections therefore to the use of plenty of light by vehicles traveling on the public highways it sounds like irrationalism of the worst type. In arguing this question the "Sun" states: "The trolley companies plead the safety of the public—the longer the radius of light the less the danger of collision." We think they are right, though the same publication subsequently derides the altruism of the traction companies. It believes the struggle for the highways between the people accustomed to using them and the electric roads which are hastily swallowing the profits once made by the steam lines is the correct view to take. It furthermore believes that keen competition has led the electrical roads to reach speeds of 20, 30 and 40 miles an hour, hence the powerful warning searchlight. Suspicion and pessimism are frequently the dominant notes in the "Sun," though couched in the choicest of phraseology. The fact of the matter is, that the people are glad to ride in the equally swift and considerably cheaper electric car wherever it parallels the steam road. Cyclists, automobilists and that historic class of sleepy-headed old farmers plodding along the track with their loaded teams express in their objections, what can only be rightly regarded as a lack of consideration for thousands of their fellow men. The cyclists and automobilists ought to remain very quiet as regards this matter. The "ploughman that homeward plods his weary way," as Gray puts it, need not find it in front of a hustling trolley car filled with equally weary people. Satire from the press regarding the acts of corporations seems to have degenerated into criticism of good acts as well as bad. As a sample of common sense, it seems that it would be difficult to find a better example than that of brightly lighting a railroad track as far in advance as possible of the moving car.

* * *

Art Fixtures in Electric Illumination.

The poetic and the prosaic are not always so closely related as in the instance of the influence of a practical system of electric lighting upon the design of chandeliers and fixtures. In this industry the incandescent and arc lamp have been made the basis of a series of artistic inventions, upon which crystallized art principles now rest. Large office building vestibules and halls, finished according to Greek or Pompeian styles of interior decoration, are illuminated by fixtures which betray the correct impression of lighting done in those days; though the light itself is provided by incandescent lamps whose ready adjustment to interpreted art ideas enables designers to carry out their plans in all essential details. Art fixtures thus represent today what they did not and could not represent twenty years ago. The ease with which concealed wires are so situated within the foliage or figure design that the art effect is enhanced by the light seeming to emanate from the thing itself, is one of the triumphs of modern art illumination. The large manufacturers of electroliers and artistically designed wall and ceiling fixtures, have long since realized that the general use of electricity is the one and only means by which these art ideas have been applied to interior design. Magnificent results have been obtained in the fine hotels and apartment houses as well as the office buildings thus equipped. This joining of interests has proved an effective spur to the development of lighting as well as the art ideals it now crystallizes.

◆

UNDER THE SEARCHLIGHT.

Notes and Comments on Various Topics.

It is reported that owing to the increased cost of material, especially copper, that the selling price of electrical machinery will be advanced about 10 per cent.

◆

Lord Rayleigh was recently elected president of the Royal Society in London. He was secretary of the Society for ten years.

◆

The leading electrical and telephone companies seem to realize—all at the same time—that their capital stock must be increased several millions. The stockholders approve, so there's "no kick coming."

◆

A company has been formed to work mines in Plymouth, Vt., which it is said contain platinum in paying quantities.

◆

The directors of the Cleveland (O.) Electric Railway Company have raised the wages of more than 2,000 motormen and conductors one cent an hour.

◆

An assistant of Prof. Ramsay at the University College, London, claims to have found a new radioactive element. It is said that the new substance is as nearly as active as radium and is a constituent of thorium, used in the manufacture of gas mantles. The substance has been named radio-thorium.

◆

President Sullivan, of the Massachusetts Electric Companies, in an address before the Board of Trade of Chelsea, Mass., said that the "average increase per mile for street railroads in Massachusetts is $10,000 with the elevated trackage included. Street railroad companies in Massachusetts are at this time approaching a critical period. They made large investments when the cost of operation was much lower than it is now. Since the time of those investments the price of rails has advanced from $19 to $27, there has been an increase of 40 per cent. in the price of copper, an increase of from 25 to 30 per cent. in the cost of cars, an increase of 50 per cent. in the cost of motors, and other necessities for railroad operation have increased in proportion. I have seen the time when one cent was considered a good profit in street railroad operation, but now the stockholders are pleased to secure a profit of six mills."

◆

During the electrical show, which will open at Chicago January 15, there will be three conventions at the Coliseum—the Northwestern Electrical Association, the Electrical Salesmen's Association and the Credit Men's Association of the Electrical Trades.

◆

The statement that the Westinghouse Machine Company equipped the new Cunard steamship, the "Carmania," with Parsons turbines, is an error. The "Carmania's" turbines were built in England, and neither the American nor the British Westinghouse interests had any connection with their construction.

◆

Dr. Herault, of France, has started his electrical smelting experiments at the Consolidated Lake Superior Company's plant at the Soo. The experiments will probably occupy a year or more. So far as Canada is concerned the steel industry will be entirely revolutionized should Dr. Herault establish the commercial feasibility of his scheme.

◆

A Christmas greeting by wireless telegraphy was sent at midnight Sunday by Admiral Manney, chief of the Bureau of Equipment, Washington, to all the naval officers in command of navy yards along the Atlantic coast and to the wireless telegraph operators. The message was: "A Merry Christmas." Aside from the sentiment of the communication, which was sent from the Washington Navy Yard to the wireless stations from Maine to Porto Rico, Cuba and the Isthmus of Panama, Admiral Manney was anxious to get some idea as to how long it would take to relay the message, if necessary, and to determine how many stations would get the message. The answer from Admiral Rogers at Guantamo broke the record for wireless telegraph achievements in the navy, and perhaps in the world, considering that the transmission was over water and land, including the mountains of Cuba. The distance in a bee-line is 1,500 miles. The nearby stations, such as New York, Atlantic City, Hampton road, etc., were easily reached and the messages came back shortly after midnight.

THE NEUCHATEL ELECTRIC TRAMWAYS.

BY C. SMITH.

The picturesque city of Neuchatel, Switzerland, with its population of nearly 36,000, has recently had an electric tramway installed, the horse car system heretofore in service being abandoned in its favor.

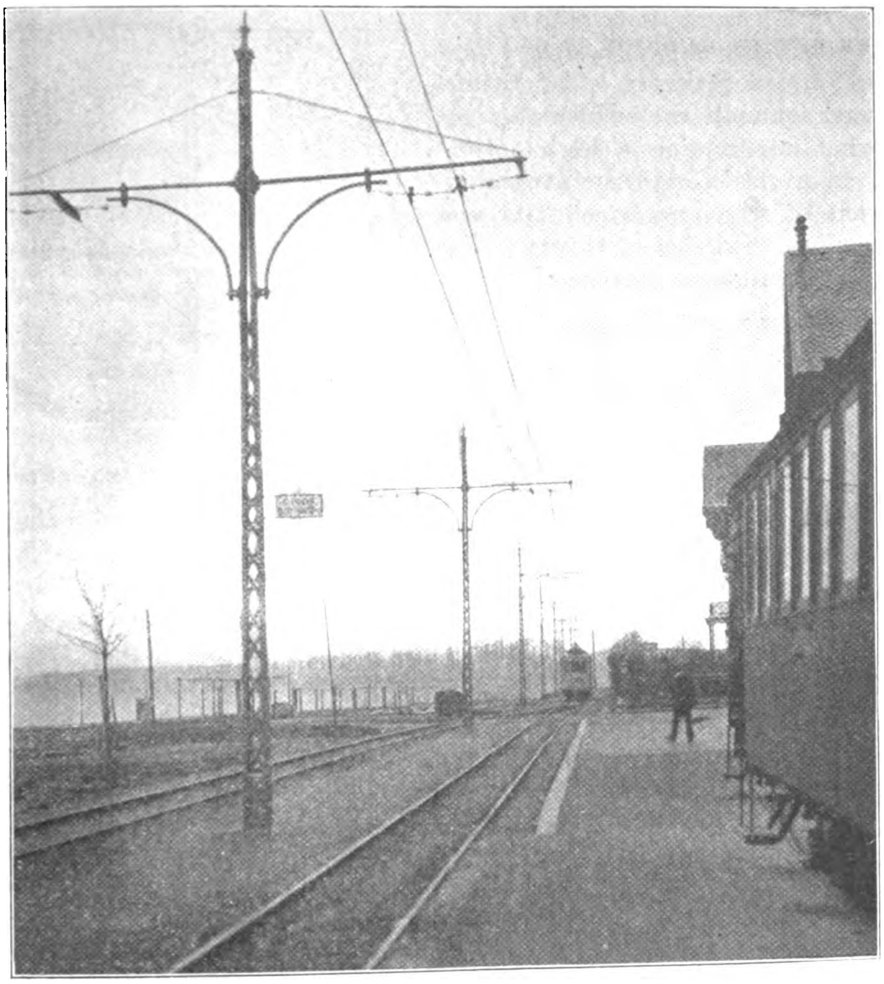


Fig. 1.—Neuchatel-Cortaillod-Boudry Line.

In 1900 the Compagnie des Tramways de Neuchatel, controlling the lines within the city, consolidated with the company owning the interurban lines, principally the Neuchatel-Cortaillod-Boudry section, so that the combined interests now operate all the numerous electric railways centering about Neuchatel. Various sections of the road were successively electrified and put into operation, the entire work having been recently completed by the Maschinenfabrik Oerlikon of Oerlikon, near Zurich, Switzerland, who were placed in entire charge of the electrical equipment and installation of this road by the Compagnie des Tramways de Neuchatel.

The direct current used is generated at a central station located in the city and is supplied to the overhead conductors at a tension of 580 volts. The interurban lines to Cortaillod and Boudry receive their current from either this power house or from the hydro-electric station of Clees.

The interurban lines centering about Neuchatel are very numerous, there being in all five separate divisions. The first section extends to St. Blaise and Serrieres and consists of 7,534 kilometers of single track and 740 meters of double track. The second line leads to the villages of Corcelles and Cormondreche, while the other three divisions extend from Neuchatel to Vauseyon and Valangin, Bahnhof, Boudry and Cortaillod respectively, the total length of track of the six lines being 26,309 kms.

The grades on all these divisions are very steep, grades of 40 per cent. and higher being met with. The gauge is ordinarily one meter, but the track construction of the various sections varies greatly owing to the fact that they were constructed at different times. The rails are of both the Vignole and Demerbe types and weigh from 20 to 33 kilograms per meter.

The tension on the line is, as before stated, 580 volts and the maximum fall of potential is 5 per cent. With the exception of the Boudry and Cortaillod section, all the overhead conductors consist of copper wire, 9 mms. in diameter placed 6 meters above the ground. Within the city iron poles are used while outside the limits wooden ones support the lines by means of the usual cross wires and rosettes used in such cases.

On the Cortaillod section the overhead conductors are octagonal wires of 100 square mm. section, and the three wire system is used, two of the conductors being overhead and the rails forming the third, there being a tension of 580 to 600 volts between the rails and either of the aerial wires, and 1,160 to 1,200 volts between the overhead conductors. In the other divisions there is but one overhead wire. Fig. 1 is a view on the Neuchatel-Cortaillod-Boudry line. It shows the overhead construction plainly, while Fig. 2 shows the tramway line entering the village of Valangin. Lightning arresters are used to protect the lines from atmospheric discharges.

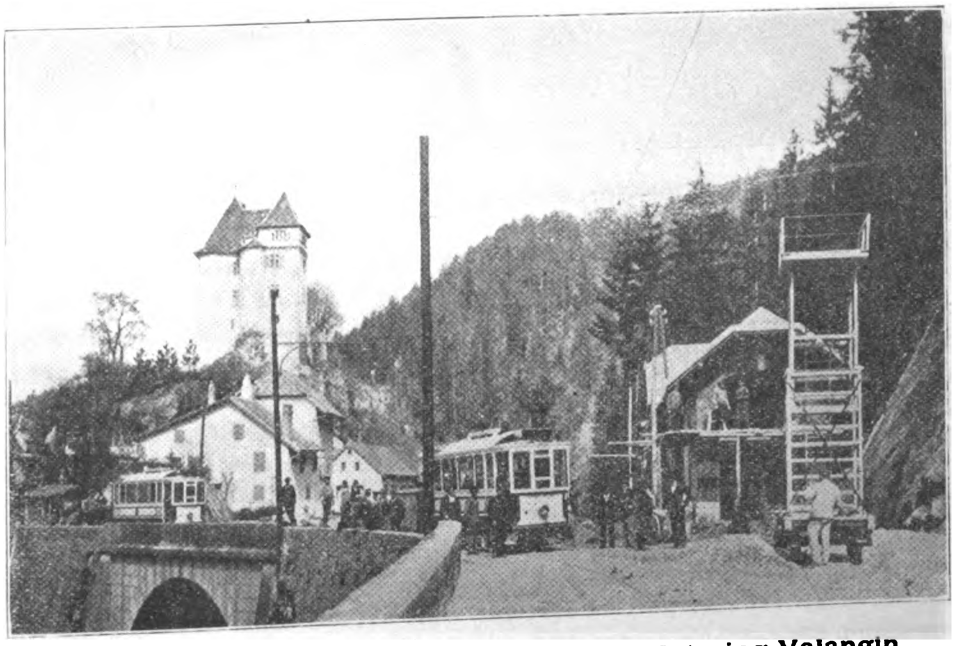


Fig. 2.—Neuchatel-Vauseyon-Valangin Line Entering Valangin.

There are in all 30 motor cars and 10 trailers in service at present, and of these

7 motor cars and 4 trailers are used on the Cortaillod-Boudry section. Three postal cars, several ballast cars and a snow-plow complete the rolling stock of this road. The cars on the majority of the lines are 8.5 meters in length, buffers included, and contain seats for 18 passengers with standing room for 16 more. Both electric and pneumatic brakes are used on these cars, which were supplied by the Compagnie d'Industrie Suisse of Neuhausen, while the Fabrique Suisse de Wagons of Schlieren furnished the larger cars for the Boudry section.

The majority of the cars have two Oerlikon motors of 18 hp. capacity, but which can develop a maximum power of 25 hp., with reduction gearing of 1 : 4.5. The lighting and heating is accomplished by electricity, six lamps being used, connected in series.

The larger cars on the Cortaillod-Boudry division are equipped with 40 hp. Oerlikon motors, which have a speed of 635 revolutions per minute, the reduction gearing being 1 : 4 in this case. The cars are lighted by 13 electric lamps, while two electric heaters, with a current consumption of 2,000 watts, are utilized for heating purposes. Fig. 3 is a view of the line near Peseux.

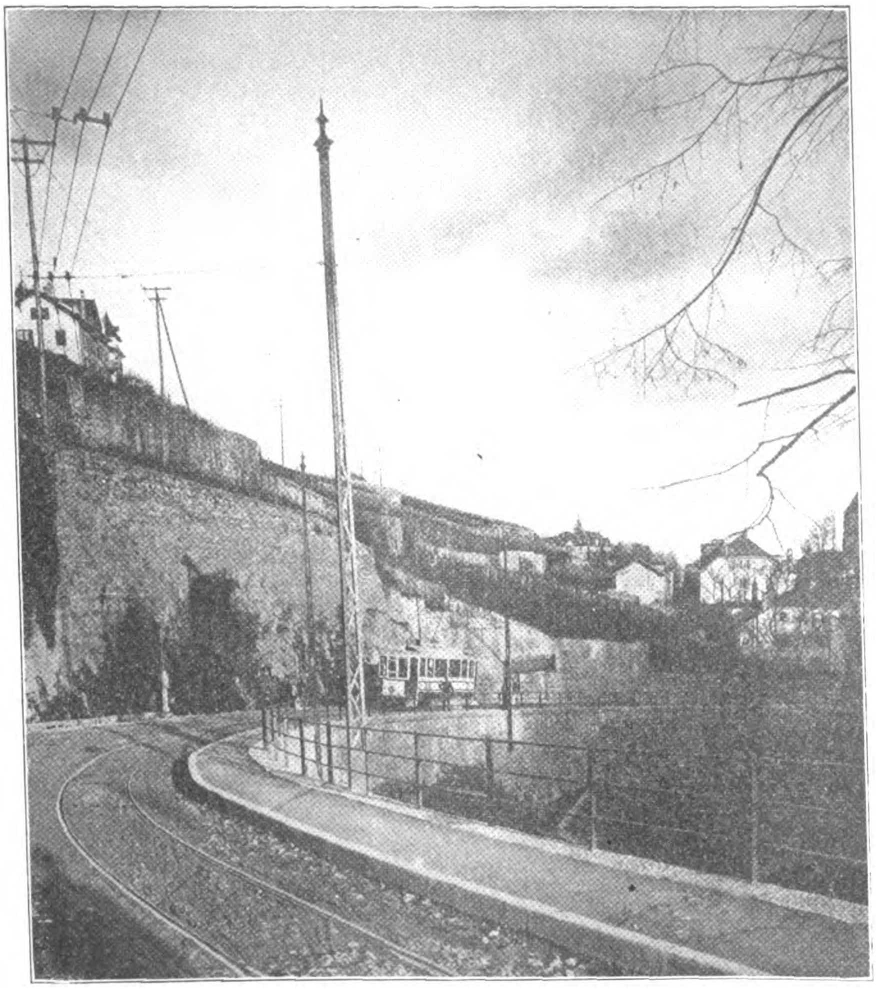


Fig. 3.—Neuchatel-Corcelles-Cormondreche Line Near Peseux.

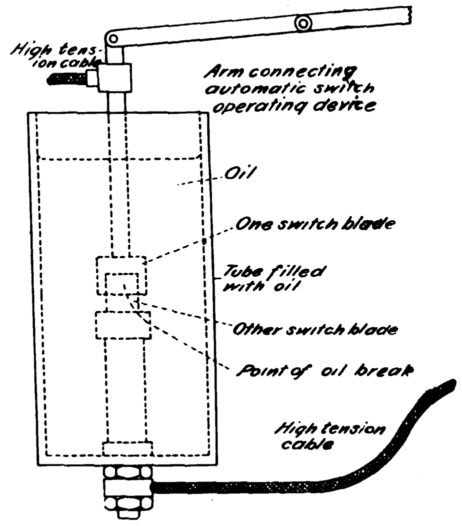
The speeds on the different sections vary greatly, running all the way from 10 to 22 kilometers per hour. The speed attained on the Cortaillod division is still higher, reaching 30 kilometers per hour.

* * *

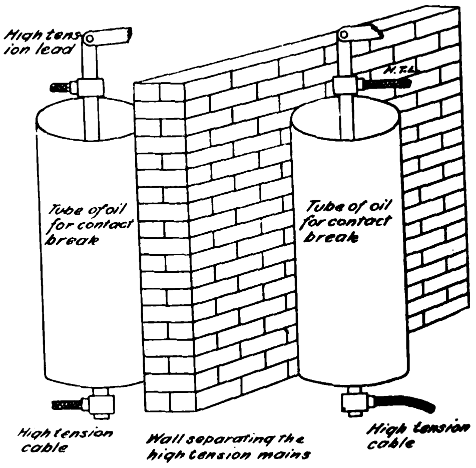
LIGHT, HEAT AND POWER PRINCIPLES.—XIV.

BY NEWTON HARRISON, E. E.

High Tension Switches.—To obviate the danger found in the sudden opening of a switch interrupting a high tension circuit an invention has been introduced by means of which such circuits are broken in oil. Switches of this type are called high tension oil switches. They are generally introduced in the main circuits leading from high tension alternators. The fact that a circuit may be made and broken under oil, has added greatly to the safety of installations requiring such protection. The commercial pressures now employed range from 2,000 to more than 60,000 volts, depending upon the nature of the plant. The safe handling of such pressures is best secured by automatic means, as it is evident that personal risks are exceedingly high, not so much because of the lack of insulation or other provision against danger, as much as the possibility of the presence of a temporary fault, giving rise to possible fatality. One large manufacturing concern makes switches operated by means of a spring and a motor. It is called the machine type oil switch, and consists of a powerful spring, which acts as the operating force in opening and closing the switch. This spring, however, is coiled by means of a motor of small size. Every time the switch is opened or closed, the motor operates automatically to an extent which is necessary to preserve the normal conditions. By this means, the station attendant is free from risks inevitably present, due to the personal handling, which would be otherwise obligatory. Long tubes are employed, to which each wire of the high tension circuit is attached; and further protection against flashing is afforded by means of a concrete partition separating the high potentials of the said wires. Flashing is one of the accompaniments of high tension circuits when made and broken under conditions which are not correct, such as defective insulation, bad contacts, or temporary defects in the switch, or in its design and construction.

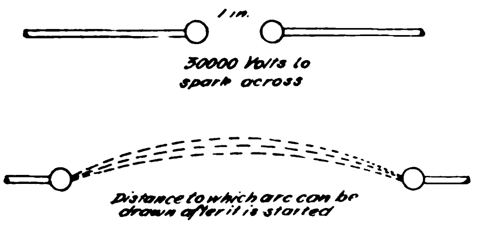


Principle of breaking a high tension circuit in oil.


High tension lead
H.T.L.
Tube of oil for contact break
Tube of oil for contact break
High tension cable
Wall separating the high tension mains
High tension cable

Principle of the method of securing a high tension break in oil.

Sparking Distances.—It is important to note the sparking distances due to different pressures in connection with high tension circuits. These distances naturally vary with external conditions, such as air pressure, moisture, etc. They are also increased in high tension circuits by the development of peculiar conditions, which momentarily raise the pressure far above its normal value. According to the figures given, the potential necessary to jump 1 inch in air is 30,000 volts, but it is also evident, that if through any cause, such as mentioned, the spark does jump across, then the arc forming will reach far more than a distance of 1 inch with a 30,000 volt pressure.


1 in.
30000 Volts to spark across
Distance to which arc can be drawn after it is started

Small distance to start spark, and great distance to which it can be drawn with the same pressure of 30,000 volts.

Pressure in volts between terminals jumped by the spark.	Distance in inches.
4,765	.04
8,140	.08
11,307	.12
14,119	.16
16,664	.20
19,210	.24
21,823	.28
22,792	.32
24,153	.36
25,071	.40
26,255	.44
27,024	.48
27,765	.52
28,359	.56
28,949	.60
29,363	.64
29,837	.68
30,133	.72
30,547	.76
30,932	.80
31,198	.84
31,494	.88

Requirements of Switches.—The requirements of switches for high and low pressure service, may be enumerated for reference in the following list of items:

SWITCH REQUIREMENTS.

1—Switches must break a pressure of from 2,000 to 60,000 volts.

2—Switches must be safe and sure in operation.

3—Switches must not burn contacts under any circumstances.

4—Switches must have perfect contact between parts that touch.

5—Switches must have a high efficiency, wasting little or no power.

6—Switches must have low heating, secured by ample cross-sections.

7—Switches must have interchangeable parts, thus securing a ready means of continuing the service in case of injury at this point.

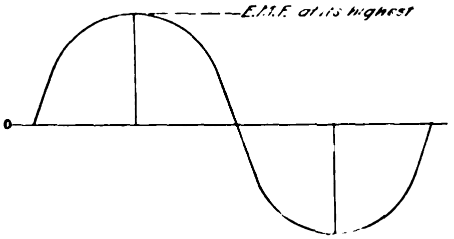
8—Switches must be constructed of non-combustible material, and thus lower fire risks to a minimum in connection with them.

9—Switch parts must be capable of ready inspection for the ready discovery of faults in case they are developing under severe service.

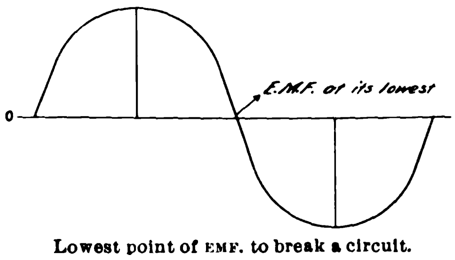
10—No exposed metal parts, thus removing the likelihood of, and freedom from, accidental contact with conductors of any description.

11—Safety to attendants, through the systematic inspection of the switches and their design, and to cover the above features of construction.

Point of Breaking the Circuit.—The breaking of a circuit carrying an alternating current is accomplished in one of two ways: either to break the circuit when the EMF. has attained the very peak of its wave, or when it has reached the lowest point of its wave. At the highest point or peak, the pressure being at its maximum, the arcing tendency is also at its greatest. According to the manufacturers of high tension switches, to quote: "The tendency to arc is much greater with a lagging current where the peaks of the wave of EMF. and current are not coincident in time, if the circuit is broken when the highest point of the EMF. is reached. The point of breaking the circuit, if of high tension alternating, is therefore that point at which conditions are most propitious—the point, in other words, at which a low pressure, or zero is found in the alternating wave."

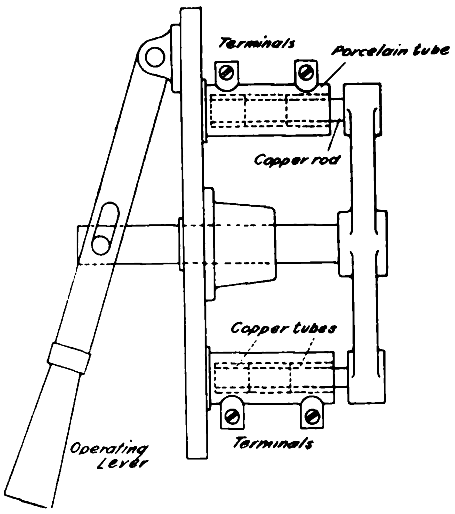


High pressure point of breaking a circuit.



Lowest point of EMF. to break a circuit.

Switches for 1,100 and 2,200 volts.—The so-called plunger type of switches were designed with the express purpose of eliminating arcing as far as possible. The principles upon which their construction is based may be covered by the following series of statements in this respect. First, the fact that arcs cannot be maintained after a circuit has been broken quickly and effectively; second, that the primary tendency of an arc is to expand until it has attained dimensions which the EMF. and resistance, according to Ohm's law, naturally demand. Third, that an arc cannot be readily maintained in a confined space; fourth, that an arc will not resist a strong transverse current of air. These features are combined in this type of apparatus and developed to meet the particular class of machines for which they were designed. The use of porcelain cylinders horizontally situated, and a marble slab upon one side of which the handle is mounted for the operators' use, and on the other side the mechanism which can be best described as given by the manufacturer's bulletin as follows: "No charged metal parts are exposed on the operating side of the base. A cast iron frame is mounted upon the back of the marble base, and serves as a support for the porcelain cylinders and as a guide for the operating rod which passes through the frame and is controlled by a handle in front. The long handle furnishes a powerful leverage and gives ease and certainty of operation. The handle being on one side of the marble slab and the switch terminals on the other side insures absolute safety to the attendant. One switch terminal is mounted at each end of a porcelain cylinder. Each cylinder has a half inch bore, through which a copper rod or plunger passes making the electrical contact between terminals. The losses in consequence of these contacts are kept very low, contact being made on all sides of the cylindrical plunger, which prevents heating and maintains a high efficiency of the switch. The plungers are self-aligning, and are entirely insulated from the iron cross head. The only charged metal on the switch consists of the plungers and the two terminals on



Mechanical operation of plunger switches.

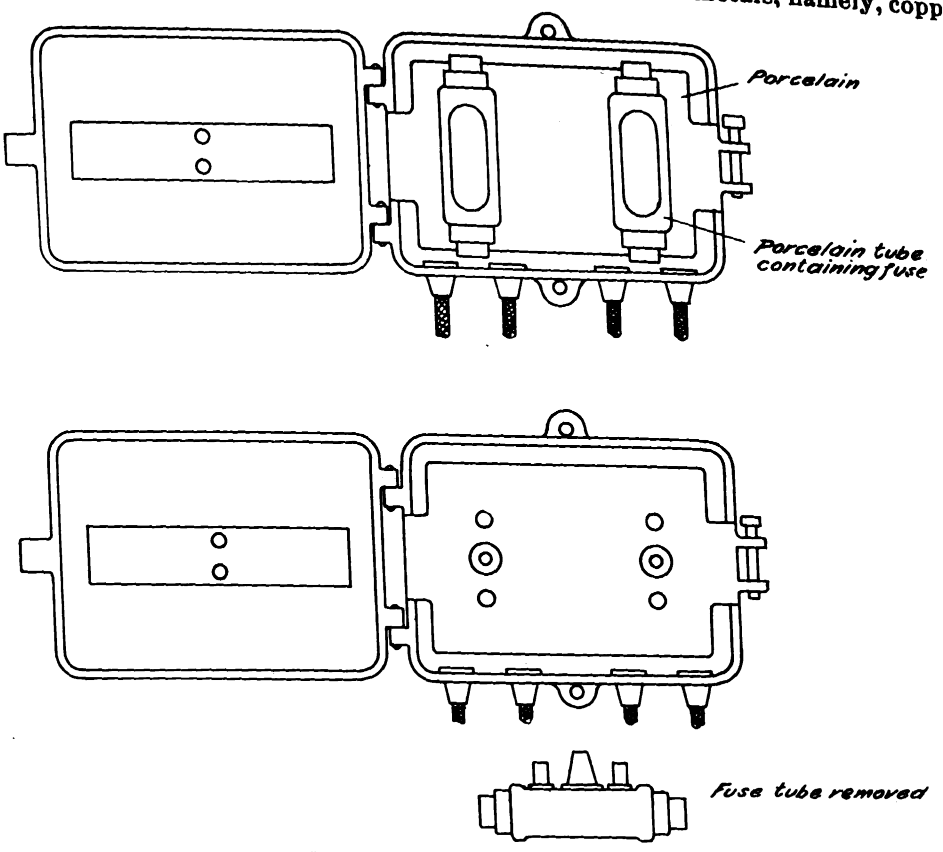
each porcelain cylinder. The cross head, operating rod and handle are completely insulated from all live metal. In opening the switch the plunger is withdrawn from the lower contact, and the arc which tends to follow it is destroyed by the combined effect of the cooling action of the porcelain walls and the draft caused by the expansion of the heated air through the outlet from the porcelain tube.

Those having one porcelain cylinder in each leg of the circuit, giving two breaks in series, are known as "single break." Switches having two porcelain cylinders in each leg, giving four breaks in series, are designated double break switches. The breaking capacity of a switch being directly affected by the character of the load, or power factor, different ratings are necessary for non-inductive loads and for loads having more or less lagging current. Current furnished to incandescent lights supplied from transformers fairly loaded has little or no lag, and is therefore practically a non-inductive load. Current to operate motors, arc lights or very lightly loaded transformers has a certain lag, the power factor being something less than 100. The power factor of 75 assumed in the table is a safe valuation for a circuit supplying general power service on many unloaded transformers. An increase in the frequency causes increased tendency to arc and consequently decreases the current breaking capacity of any given switch."

BREAKING CAPACITY OF PLUNGER SWITCHES.

Character of load,	Lighting or non-inductive load.				Power load with a power factor of not less than 75 per cent.			
Alternations	7,200		16,000		7,200		16,000	
Voltage	1,100	2,200	1,100	2,200	1,100		2,200	
Breaking capacity in amperes for single break	100	50	100	50	60	25	25	
Breaking capacity in amperes for double break	200	100	200	100	150	75	50	30

The principle followed out in switch design, is one from which the best lesson can be taught as far as construction is concerned. It is the fact, that the number of breaks in the circuit will to a certain extent determine the amperage that can be arrested. For instance in the table given of such items the breaking capacity of a single and double break switch of the same number of cycles per second is as 2 is to 1. The rating of the switches differs, but their carrying capacities are all 200 amperes. The rating is therefore determined by the breaks in the circuit and not as might be supposed, by the actual capacity of the switch.



Fuse boxes with removable tube fuses.

Transformer Fuse Blocks.—The protection of the primary circuit against overflows of current is best secured by means of fuses attached to specially constructed fuse blocks. Fuse blocks are constructed so that they may be readily applied to service at any convenient point on or near the transformer. The fuse wire itself is made of an alloy of lead and antimony or other metal, which fuses at a fixed temperature with a given current. It is protected from injury by being inserted in a porcelain tube, as well as acting to protect the lineman's hands from injury in case it volatilizes while being inserted. It is recommended that lead wire be used for currents of 10 amperes or less, and for higher currents, copper or aluminum. The sizes relating to these latter two metals, namely, copper and aluminum, are given as follows:

GAUGE SIZES AND CURRENTS OF COPPER AND ALUMINUM FUSE WIRES.

Current in amperes.	Size of wire in B & S gauge for copper.	Size of wire in B & S gauge for aluminum.
10 to 15	No. 24 B & S	NO. 23 B & S
15 to 20	No. 23 B & S	No. 22 B & S
20 to 25	No. 22 B & S	No. 21 B & S
25 to 30	No. 21 B & S	No. 20 B & S

Single and Double Pole Fuse Boxes.—For pressures of from 1,000 to 3,000 volts the regular single pole fuse block is limited by its construction to the use of fuses of the character designated above. The double pole fuse block employed for similar voltages is generally found in service with transformers not exceeding 10 kw. capacity of 1,000 volts pressure; and for transformers not exceeding 4 kw. capacity of about 3,000 volts pressure. The amperes vary in all cases, as far as these capacities are concerned, from 10 to 30. The unique features of construction are found in the use of porcelain tubes containing the fuses. These are air-tight, with the exception of a small opening at the back to allow gases to escape. Arcing is rendered impossible by the very nature of the space in which it occurs, the arc extinguishing itself automatically. The tubes are held in place by strong spring clips, which also serve as a switch, because when the tubes are lifted out only the primary of the transformer is entirely disconnected. Through the use of this principle the tubes can be lifted out and loaded with new fuses without unusual risk to the lineman. On the other hand, the blowing of the fuses means a sudden expansion within the tube, the effect of which is to destroy any arc about to form. Lateral expansion in this case is an absolutely reliable means of destroying arcs naturally tending to form with high pressure circuits.

PRIME MOVERS FOR GENERATORS.

BY W. H. WAKEMAN.

ARTICLE I.

Timid and superficial students, or readers of the mechanical papers, sometimes ask if the electric motor will entirely supersede the steam engine, but there is no more danger of it than of the passenger car superseding the locomotive, for the simple reason that the electric motor is not a prime mover. How, then, can it displace a prime mover in a broad sense of the word?

When a party who has been using a small steam engine in his business concludes to dispose of it and install an electric motor in its place it always leads somebody to conclude that the steam engine is doomed. They seldom stop to consider that the power this man continues to use is still produced by means of the steam engine, although said engine is in a big power house down town and the power comes up over a wire or two, therefore just as much steam power is used in that place as ever before.

It is not always necessary to use a steam engine for this purpose, however, as other prime movers are available for this purpose, and to call attention to these is the object of this article.

There are scores of towns and small cities that are within reasonable distance of a stream of water flowing down from a mountain that is capable of developing power enough to run several shops during the day and light the place at night. This could be utilized to run a generator producing current at a high voltage that can be transmitted a few miles with small loss of energy.

A motor can be installed at some suitable place and run by this current. Two generators may be located on the same shaft, one for a constant potential direct current of 220 volts to a three wire distributing system, supplying incandescent lamps at 110 volts potential, and motors of either 110 or 220 volts to good advantage. The other generator can be used to supply a constant current system of street illumination that gives satisfactory results.

Fig. 1 shows this motor and the generators or dynamos mentioned, with a clutch on either side of the motor, so that either generator may be stopped at pleasure.

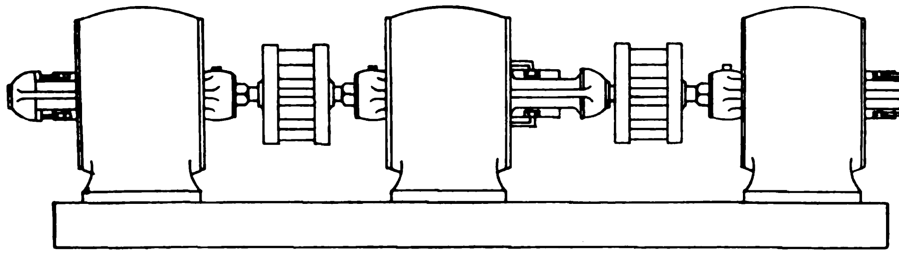


FIG. 1.

It may be well to state in this connection that with a constant potential system, the voltage does not change when lights are turned on or off, as more or less current or amperage is supplied to meet the changing demand.

Where a constant current system is used the amperage does not change, but is usually maintained at about 10 amperes. As more or less light is wanted the potential or voltage is changed to meet different requirements.

The greatest rival of the steam engine at the present time is the gas or gasoline engine. Fig. 2 illustrates a gas engine direct connected to a slow speed dynamo. This popular form of prime mover would be used even more than it is were it not for some of the objections to it.

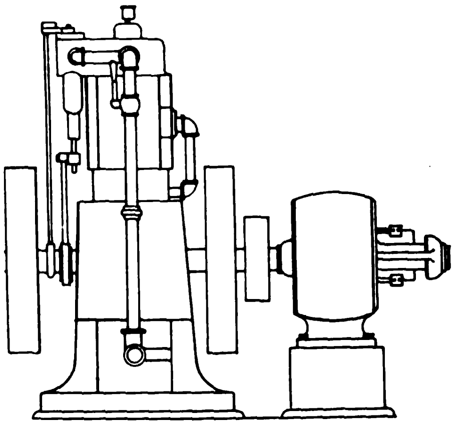


FIG. 2.

While this machine does not require a boiler, still a gas engine alone frequently costs as much as a steam engine and boiler together, which eliminates the advantage mentioned, so far as first cost is concerned, and that is a very important consideration in a majority of cases.

The reason for this great first cost is partly due to the fact that for the same power a gas engine must be much larger than a steam engine. The latter develops power at every stroke, while the former gets an impulse and develops power at every other stroke, if it is of the two cycle type, or once in four strokes for the four cycle kind. This makes it necessary to provide two heavy balance wheels on the engine, and sometimes one is put on the dynamo. These are not fly-wheels (although they are sometimes called by this name), for that signifies a wheel that carries the main belt on an engine.

A gas or gasoline engine may be used to charge a storage battery that will supply lights that burn steadily, but this method is too costly and cumbersome for general use on a large scale. This prime mover must be started by some external means, and this is an objection to the smaller sizes, as they are usually started by turning a crank which is sometimes dangerous and always disagreeable. Where the plant is large enough to warrant it devices for compressing and storing air are installed. The gas engine is then started by compressed air in almost the same way that a steam engine is started, and when full speed is attained the air is shut off and gasoline admitted.

If an engine of this type is overloaded it will stop instead of slacking up and continuing to run at a lower speed. If this takes place with a load ef electric lights, making it necessary to restart the whole plant, it causes much trouble and annoyance which cannot be tolerated.

In the vicinity of my desk there is a large plant for making producer gas that is used in gas engines that are direct connected to generators. These supply current to run motors in many parts of a large shop, proving economical in the use of fuel and satisfactory on general principles.

The manufacture of producer gas is a very simple process. It consists of putting a layer of coal several feet thick into a hopper prepared for the purpose. The lower part of this coal is kept burning brightly by a mixture of steam and air forced upward through it, resulting in gas composed of carbonic monoxide, hydrogen and nitrogen.

The latter is not wanted as it is of no value whatever, but it seems to be inseparable from the use of air that is required to burn the coal. When this gas is burned directly in the cylinder of an engine it completes an economical process.

Steam can be produced in a boiler under practical every day conditions with but little loss of heat contained in the coal. This is mentioned here because it is frequently misunderstood, and the steam plant unjustly condemned. The unavoidable loss is due almost entirely to the fact that a greater portion of the heat is lost in the exhaust steam, as no means of utilizing it in the production of power, have yet been discovered.

THE YOUNG IDEA.*

Scene.—Engineer's office at power station.

Time.—Office hours, any day, all the year round.

Curtain lifts and discloses engineer surrounded by papers, drawings, files and baskets, deeply engrossed in manipulation of inevitable slide-rule.

Enter, after knocking, portly dame in red hat, trimmed to overflowing with green feathers, and wearing complete week-end costume.

She advances against the engineer, smiling fearfully, draws a chair to her, sits down in a strategic enfilading position, and opens fire thus:

P. D.—I think you look after the electricity engines, don't you? This electricity is such a wonderful thing, isn't it? It always puzzles me, you know, but I should like to find out all about it. My husband's brother's brother-in-law does a bit at it in his spare time; you know him, I daresay—Tom Jones, lives just a few doors down our road; I'm Mrs. Hawkins, 101 Bell Street—put that down so's you don't forget it. As I was saying, he's a clever chap, Mr. Jones is, knows all about the bells, and puts our electricity to rights when he comes round to have a bit of tripe with us—won't you come one evening to meet him, he'd be very pleased, I'm sure? No formalness about him, you know. Well, as I was just going to say, when you put it out of my head, this young feller used to try to explain all about the electricity and magneticizm to me and Hezekiah—that's my husband, you'll like Hez.—but I couldn't keep up to him, and I says: "You're too clever for me, Tom, I says, but you give it to Henry"—that's my boy, he's 14 come Michaelmas—"you give it all to him, and praps he'll make an electricianer one day. So Tom tells the dear lad all about the positives and negaltives, and how he's never to touch anything painted red, because its sure to be magneticized and might kill him dead, and he shows him what he calls experiments with rulers and sealing wax picking up things; so that Henry knows nearly as much about it as Tom, and is forever cutting the bell-wires and joining them up again, and stopping the bells ringing, until I wish he wasn't so clever. Well, what I came here for was to ask you whether you can find him something to do about your engines. He wouldn't want much to begin with, because he might have to be taught a few little things—place might be a bit strange like—but you'd find him a clever lad. Now, what do you think about it?

Engineer.—Madam, at the present moment I am incapable of thought. If you would be good enough to leave your address—oh! yes, I have it here—I will communicate with you later. Good morning m'a'm.

P. D. (rising).—Thank you very much. I forgot to show you his photo. Here it is, but I always say it isn't very flattering. (Hands cabinet photograph of sickly looking youth dressed in a black suit that looks as if it had been cast on him, standing straight up with heels together, one hand stiff at his side and the other resting—planted would be a better term—on a couple of large books, which lie on a wool-work mat at the edge of an oval table with one central leg.) Praps you would like to keep it by you for a day or two. I'm sorry you can't give me an answer now, but I'll call round again in a day or two. It's no trouble at all, thank you, because I often have to be passing. Good morning sir. I am glad to see you looking so well. Any evening you like to call we shall be glad to make you welcome. Good morning. I wish I had time to stop and find out something about this electricity. Such a wonderful thing, I always say, and (looks at engineer admiringly) I suppose you know all about it. Well, good morning, I hope I have not interrupted your business at all, but I expect you are glad to see people sometimes, it must be so lonely up here all by yourself. What a funny card! What does it say. "For every minute I am delayed I have to work overtime!" Well, I never! You don't mean to say they're that hard on you? I wouldn't have Henry treated like that! What a shame! Well, of course, they can't say I've delayed you, because I came on business. Good morning (leaves).

Engineer.—Good morning, madam. (Presses one of a row of buttons on his desk. Presently enter boy.)

Engineer.—If you ever show that woman up here again you young scoundrel I'll break your silly little head!

(*Curtain falls on boy expostulating, and then dodging something heavy.*)

SOME CONSIDERATIONS DETERMINING THE LOCATION OF ELECTRIC RAILWAY SUB-STATIONS.*

BY C. W. RICKER.

No attempt will be made in this paper to define the conditions under which indirect distribution, through the medium of transformer sub-stations, is more economical than direct distribution from one or more generating stations containing prime movers. It is assumed that because of the size of the railways to be considered, and the local conditions determining the cost of generating power, the indirect method of distribution has been selected as offering the best economy in commercial operation, and an attempt will be made to outline a general method for determining the number and location of sub-stations.

In many cases, perhaps the majority of cases, a general solution of this problem is quite impossible. Most of the large electric railway systems now in existence are the result of development not foreseen by their original projectors, and there is little reason to believe that future systems will be very widely different in this respect, but probably they will continue to grow by extensions and consolidations depending upon the distribution and development of local centers of industry and population.

For convenience of discussion, electric railways large enough to require indirect distribution may be classified as follows:

1. Large simple networks, serving a single community.
2. Long single lines or groups of such lines, connecting separate communities or different parts of a very large one.
3. Complex networks, with connecting lines, serving a city and its suburbs.
4. Several networks with long connecting lines, serving separated communities.

Railways of the last named class are usually consolidations of the local systems of neighboring cities or towns, and interurban lines which frequently furnish power for lighting and general use in the towns served. There are usually well-marked centers of load which, together with local business conditions, determine the position and equipment of sub-stations.

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* Communicated to the "Electrical Review," London.

* Paper presented at the 202d meeting of the American Institute of Electrical Engineers, New York, December 15, 1905.

Railways of class 3, those serving a large city and its suburbs, are also most often the result of the consolidation of separate lines and networks, and while the large central network belongs in class 1 the outlying districts present a difficult problem to the engineer, for he must anticipate the direction, character, and sequence of growth so as to provide against it. This requires an intimate knowledge of local conditions, both industrial and social, and in addition he has need to be something of a prophet to foresee the changes which the building of new lines and the starting up of new works may produce. The problem is a local and particular one, and must depend mainly upon individual judgment for its solution.

Classes 1 and 2 can be treated more generally. Take first the case in which a large network, or long line or group of lines, is contained wholly within a large city, so that a fairly uniform schedule can be operated over the whole, and the mean load upon each mile of road is approximately uniform throughout the system, at any given time. It is required to adjust the cost of losses in the primary distribution, the secondary distribution, including the track, and the sub-stations, the fixed charges upon each of these three divisions, and the cost of sub-station attendance, so that their sum shall be a minimum, with due regard to the conditions of regulation and continuity of service.

As the density of the load in such a system is very great, the unit of sub-station equipment may be made large enough, so that at the time of least load, one unit per sub-station may be operated at or near its best efficiency. Hence the sub-station losses per kilowatt-hour may be considered constant.

The aggregate capacity of the sub-stations will equal the capacity of the generating station plus the sub-station reserve capacity, if any is necessary, which will not exceed one unit per sub-station. The greater the distance between sub-stations, the larger the sub-station unit will be; hence the cost of sub-station apparatus will decrease as the number of sub-stations increases, until the largest practicable unit is reached. The same is true of sub-station land and buildings.

The cost of sub-station attendance will depend only upon the number of sub-stations, as the same number of attendants is required in a small as in a large sub-station, unless the cost of land makes it necessary to double-deck the sub-stations, which will cause a sharp rise in the cost of attendance when the number of units becomes greater than can be placed on one floor.

When direct-current motors are used, the secondary voltage is fixed by conditions of standard practice. The secondary conductors may be proportioned by Kelvin's law, subject to the limiting condition that the lowest potential shall be enough to allow the required acceleration. As the number of sub-stations increases, the cost of the conductors will decrease rapidly. The energy losses in the conductors may be constant or decreasing. The primary distribution in this case must be by underground cables. The primary voltage will be determined by the relative cost of copper and insulation, and should be as high as is consistent with safety. Hence the losses per mean kilowatt in the primary distribution may be considered constant. The total weight of primary conductors will be practically independent of the number of sub-stations, depending upon the total energy and the mean distance of distribution, and may be determined by Kelvin's law.

To obtain the greatest reliability of service, each sub-station should be fed directly from the generating station by at least three cables, and in the case of a wide difference in the number of sub-stations considered, the total cost of cables and conduits would be somewhat greater with the larger number of sub-stations as more and smaller cables would be required. Otherwise the cost of the high-tension distribution, and the losses in it, may be considered constant.

Neglecting those quantities which are constant, the fixed charges on sub-station land, buildings and apparatus, and the cost of sub-station attendance increase as the number of sub-stations increases; the fixed charges on the secondary distributions decrease and the losses in the secondary distribution decrease or remain constant.

The various losses and charges upon which the solution of the problem depends may then be considered as constants or variables dependent directly upon the number of sub-stations and inversely upon the distance between sub-stations. These quantities may be reduced to a common base of annual kilowatt hours, and curves representing them may be drawn with respect to the number of sub-stations as one co-ordinate, and a summational curve may be drawn which, if the premises are rightly chosen, will indicate the number of sub-stations at which the sum of the various charges is a minimum.

In a far greater number of railways the load is not uniform throughout the system. This is true especially of the long interurban railways using a comparatively small number of heavy train units. The load at any given time is concentrated upon parts of the system, or travels from end to end of the long lines. In such a system, the aggregate capacity of the sub-station apparatus in operation at any given time is greater than that of the generators; hence the load-factor of the sub-stations is unfavorable, and in most cases the power-factor of the system is low.

In a solution by the method outlined in this paper, several new curves must be drawn in addition to those named. The first showing the all day losses in the sub-station apparatus, which will increase with the number of sub-stations. The second showing the losses in the primary transmission lines, which will also increase with the number of sub-stations, due to the greater length of lines and to the lower power-factor. The third showing the fixed charges on the primary transmission lines.

The last two curves are relatively much less important. It is possible by compounding or automatic adjustment of fields, to keep the power-factor of the synchronous converters very near unity, making the transmission losses more nearly constant, and independent of the number of sub-stations. In such systems it is not usual, and seldom practicable, to use separate feeders from the generating station to each sub-station; and the primary distribution is usually by overhead lines, generally supported on poles, which are used for other conductors as well. But with all the sub-stations along a single line of railway, or a group of such lines connected to one transmission line, the additional cost of extending the same for a greater number of sub-stations will usually be but a small part of the whole expense. So, for at least a preliminary consideration of the problem, the last two curves may be omitted and the same quantities used as are considered in the solution for a road having a uniform distribution of load, with the addition of one containing the all-day losses of the sub-station apparatus.

In systems consisting of long lines with infrequent train service, the cost of attendance and all-day losses in converter sub-stations often becomes so great that the regulation in secondary conductors economically proportioned for standard direct-current voltage will not permit the operation of the required schedule. The usual remedy is to set the sub-stations nearer together, though at the cost of operating economy.

If other conditions still make the use of standard direct-current equipment desirable, it would seem that better economy could be obtained by lengthening the sub-station sections and using boosters, just as has been found profitable in the supply of such lines of less length from direct-current generating stations. The fixed charges on and losses in the boosters should then be included in the curves of sub-station apparatus.

In the discussion of the method of treating the problem of sub-station location herein suggested, the usual type of converter sub-station, with direct current, secondary distribution has been kept in mind, but the method is no less applicable to a complete alternating-current system with static sub-stations, in which case the curves of sub-station losses, attendance and fixed charges, all become flatter, while the higher trolley voltage available, permits a wider spacing of sub-stations, without exceeding the limiting conditions of regulation, all of which indicate a better efficiency of sub-station apparatus and secondary distribution, in roads of low and non-uniform load density.

NOTES ON THE STANDARDIZATION OF FUSES.*

BY ALFRED SCHWARTZ.

The fuse in this country is considered by most engineers to be a tricky and unreliable piece of apparatus; it is often spoken of as if it were on the point of being superseded by the circuit-breaker—presumably in all sizes—and in general it is regarded by the up-to-date man as a legacy from the dark ages (i. e., the transition period between the gas age and the era of electricity), and further, he considers that while it has to be tolerated as a necessary nuisance, it is entirely unworthy of the care and attention that he lavishes upon other portions of his electrical equipment.

Whenever a fire takes place on premises in which the electric light has been installed, it is in the first instance invariably attributed by the lay press to "the fusion of the electric wires." In most cases, however, it is ultimately traced to the gas or heating arrangements, but it is none the less our business to insure the safety of the electric system by a well considered system of fuses, so arranged that their abuse shall be made as difficult as possible, and that their overload capacity shall be of a predetermined value.

Before considering in detail the various points in connection with fuses in which standardization appears to be desirable, we must clearly recognize that no amount of standardization will prevent willful and determined tampering with a fuse. Careful standardization will, however, reduce this danger to a minimum, by the selection of a form of terminal which will render its misuse as troublesome as possible; while at the same time the ability to obtain from any dealer's stock the standard fuse required would render the legitimate replacement of the fuse far easier than it is at present.

Let us now briefly consider seriatim the particulars in connection with which standardization could be advantageous:—

Length of Break.—The fire risk in connection with fuses should be greatly reduced, first, by standardizing the length of break not only for various circuit voltages, but also for various carrying capacities.

The sudden breaking of a heavy short-circuit current by a fuse produces an inductive pressure rise which may be very many times that of the line voltage. This is brought about by the collapse on breaking of the magnetic field due to the short-circuit current; this current if limited only by the resistance and self-induction of the circuit would reach a very high value—possibly from 5,000 to 10,000 amperes on an ordinary service fused for 50 amperes. If the circuit is properly fused, however, it will be opened before the current has had time to mount to the value named above, and the short-circuit current would in the case named be limited to about 1,000 amperes. The greater the capacity of the fuse the longer it will take to melt on short-circuit, and in consequence the pressure rise will reach a proportionately greater value. A standard increase in the length of break with increased carrying capacity should therefore greatly reduce the chances of the persistence of the arc and consequently the fire risk.

Short-Circuit Service.—The term short circuit is a relative one, and the effects which one may get on a consumer's premises connected to a large network are very much less severe than those obtainable on the station bus-bars. Some discrimination should therefore be used in standardizing, in order to avoid throwing on the general consumer the burden of the greater cost necessary for a fuse to withstand station conditions. Possibly two classes might be formed, one for fuses (usually of large carrying capacity) to withstand the severe conditions of a true short circuit, the other for fuses (usually of small carrying capacity) for use on circuits of a non-inductive character and of moderate resistance, such as one usually finds in connection with house installation work. As an alternative, some mean condition between these two might be specified in connection with the tests on short circuit with which the fuses would have to comply.

Material of Fuse.—It would appear desirable to specify the material, shape and arrangement of the fuse metal to meet the requirements of circuits which are capable of bearing different amounts of overload. For instance, an ordinary lighting circuit can usually safely withstand an overload of 100 per cent., and it is not desirable on such a circuit that the fuse should come into operation with a less excess current than that named; fuses arranged and rated to meet these conditions might be termed "insensitive" fuses. Arrangements might, however, be made for a further class or classes which would operate with excess currents of from 10 to 50 per cent., and which might be termed "sensitive fuses." Generally speaking, fuses of large carrying capacity would be placed in the latter class. Other points to be considered in connection with the choice of metals are:

1. The degree of purity obtainable commercially.
2. Resistance to oxidation at the temperature of normal working.
3. Freedom from the formation of an oxide skin of sufficient strength to hold up the metal when molten.
4. The non-arcing properties of the metal vapor.
5. The characteristics on disruption as to the formation of heavy vapors, the degree of scattering of the molten particles of metal, and their condition as to temperature, etc.
6. The contact difference of potential between the fuse metal and the terminals.
7. The coefficient of expansion of the fuse metal relative to that of the terminals or binding screws.
8. The form in which the metal is available whether in wire or strip, and its capability of being soldered satisfactorily.

Rating.—The normal fusing current for the materials sanctioned should be carefully determined for the requisite ranges, and the fuses stamped with the normal carrying capacity, and the fusing current and "sensitiveness" expressed as the percentage overload at which fusion takes place, the overload being reckoned as excess over the normal carrying capacity. The time should be specified within which the fuse must blow when started cold with the specified overload; this time will, of course, vary with the capacity of the fuse, and will be greater for inclosed fuses than for the open type.

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*Abstract from the "Electrical Review," London.

Testing.—Arrangements should be made for standardizing the conditions and details of the following tests:

1. Normal fusing current.
2. Short circuits.
3. Arcing on fusion with currents slightly in excess of the normal fusing current.
4. Temperature rise for inclosed fuse covers.
5. Insulation between parts.

The normal fusing current for a wire may be defined as the minimum current required to fuse the wire in such a time interval as shall be necessary for the wire to have attained its maximum steady temperature. In order to obtain accurate results, sufficient time must be allowed for this to occur; for open type fuses a method of procedure can be detailed which will insure this, but for semi-inclosed and inclosed fuses the time interval necessary to bring them up to a given temperature will depend upon the special environment of the wire.

Contacts.—There are as a rule two sets of contacts to be considered:

1. The contact between the fuse wire or strip, and the end plate or ferrule of the holder or cartridge.
2. The contact between the end plates or ferrules of the holder and the clip jaws or terminals of the fuse block.

In some fuses of open type for fairly large currents, where the strip employed is of sufficient strength, it is forced edgeways between the spring terminal clips by means of an insulated grip handle, which can be removed when the fuse strip is in position, thus obviating one of the sets of contacts mentioned above. With regard to the contacts on the holders in the inclosed type, the fuse metal is usually soldered to the end caps, while in the open type it is usually held under a screw and washer. Where the fuse metal has approximately the same coefficient of expansion as the terminal, not much trouble is experienced, particularly with strip, but where the expansions are different, flattening of the wire may occur, and a loose contact will be developed. Where one of the metals is highly electro-positive to the other, local action will take place in damp situations, with consequent corrosion at the contacts. The form of contact between the fuse holder and the fuse block requires careful consideration; the knife blade and spring clip seems the most promising, as it is simple in construction and avoids the use of screwdrivers for replacement or disconnection, and it will, further, not become loose under working conditions. The only point against it is that it rather lends itself to abuse by the substitution of a strip of metal or wires in place of the fuse holder, but this could doubtless be overcome by a suitable arrangement of the block and terminals.

The spacing of the fuses should also be detailed, so as to secure a minimum distance between terminals of the same polarity, to allow of safe and easy handling. For fuses of the open type, incombustible septa of insulating material should be fixed between the fuses to limit the spread of the molten metal; the arrangement should also be such as to prevent accidental short circuit between live metal parts of opposite polarity. Open type fuses should preferably be arranged horizontally rather than vertically, as this is less likely to persist; the normal fusing current will, however, be increased by about 5 per cent.

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Meeting of the Independent Telephone Association of Wisconsin.

The Independent Telephone Association of Wisconsin held its convention at the Hotel Pfister, Milwaukee. December 21.

President Harper, in referring to companies who "made peace with the Bell," said: "I think that the traitors are about all in now and they have landed about all that they can land."

The secretary's report showed that Wisconsin has 300 independent telephone companies with an investment of $4,000,000; 1,300 toll stations, 375 exchanges and 42,000 subscribers.

The following officers were unanimously elected:

President—Richard Valentine, Janesville.

Vice-President—J. C. Kuoni, Sauk City.

Secretary and Treasurer—W. F. Goodrich, La Crosse.

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Proposals Invited.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until January 9 for furnishing Eastern Navy Yards with the following electrical material: Schedule 294, arc lamp globes, wire, tape, fuses and miscellaneous supplies. Blank proposals can be obtained at the Navy Pay Office in New York or upon application to the Bureau at Washington.

ELECTRICAL PATENT RECORD.

LETTERS PATENT ISSUED DEC. 19, 1905.

Electric Railways and Appliances.

807,431. Electric Controlling Mechanism for Railway Appliances. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, same place. Filed June 3, 1905.

807,451. Car-Fender. Edward C. Haynes, Portland, Ore. Filed Aug. 23, 1905.

807,463. Self-Lubricating Trolley-Wheel. John Hensley, Huntington, Ind. Filed July 8, 1905.

807,477. Trolley. Allen P. Lord, Bradford, Pa. Filed Jan 9, 1905.

807,490. Car Fender. Frederick W. O'Connor, Toronto, Can. Filed May 8, 1905.

807,590. Railway Signal-Repeater. Frederick B. Wiegand and William V. Moak, Utica, and Francis B. Harrington, Menands, N. Y. Filed July 15, 1905.

807,653. Trolley for Electric Railway. Walter J. Barron, Brooklyn, N.Y. Filed June 6, 1900.

807.707-800. Electric Railway-Signal and Electric Railway Signaling Appliance. Henry A. Ammann and Albert D. Campbell, Spokane, Wash. Filed April 6, 1905.

807.895. Railway Signaling System. Henry Bezer, New Rochelle, N. Y. Filed May 25, 1895.

Electric Lights and Appliances.

807,671. Combined Socket and Plug for Incandescent Lamps. Henry W. Gremmels, Denver, Col., assignor of one-half to Martin J. Jackson, same place. Filed Jan. 3. 1905.

807,860. Electric-Hand-Lamp Contact. George L. Patterson, New York City, assignor to Alice C. Patterson, same place. Filed Dec. 30, 1904.

Electrical Machinery and Apparatus.

807,434. Casing and Terminal Block for Electrical Measuring Instruments. William M. Bradshaw, Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed March 17, 1905.

807,517. Magnetic Work-Holder. Walter N. Vance, Chicago, Ill. Filed July 31, 1905.

807,520. Controller. Ferdinand Volk, Pittsburg, Pa. assignor, by direct and mesne assignments, of one-third to John A. Rogan and one-third to John Murphy, Pittsburg, Pa. Filed Feb. 4, 1905.

807,634. Circuit-Controlling Device. Gwynne E. Painter, Baltimore, Md. Filed July 18, 1903.

807,747. Insulating-Casing for Wire Connections. Louis A. Kling, Elizabeth, N J. Filed May 27, 1904.

807,847. Lightning-Arrester. Ernest S. Moorer, Anderson, S. C. Filed May 9, 1905.

807,858. Controller for Electric Motors. William A. Paris, Edgewood Park, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed April 3, 1905.

807,937-938-939. Electric Motor Controller, Control System for Electric Motors and Controller for Electric Motors. Henry D. James, Pittsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company. Filed April 3, 1905.

807,943. Regulating Means for Systems of Electrical Distribution. Benjamin G. Lamme and Charles F. Scott, Pittsburg, and Frank Conrad, Edgewood Park, Pa., assignors to the Westinghouse Electric & Manufacturing Company. Filed Feb. 1, 1905.

Telephones and Telephone Apparatus.

807,575. Means for Restoring Ring-off Drops for Switch-Boards. Ewing McLean, Greencastle, Ind. Filed Nov. 21, 1904.

807,596. Telephony. Edward A. Buell, Dekalb, Ill., assignor to the Selective Signal & Telephone Manufacturing Company, Sycamore, Ill. Filed Oct. 6, 1904.

807,806. Telephone. John H. Boyd, Valden, Miss. Filed Dec. 28, 1904.

807,859. Annunciator. James Patten and William Patten, New York City. Filed April 5, 1905.

807,942. Telephone-Directory. Edward N. Lake, Chicago, Ill. Filed Aug. 22, 1904.

Miscellaneous.

807,673. X-Ray Tube. Emil Gundelach, Gehlberg, Germany. Filed Dec. 16, 1904.

807,708. Electromagnet Recording Appliance. Henry A. Ammann and Albert D. Campbell, Spokane, Wash. Filed Feb. 17, 1905.

807,718. Thermostat. Peabody A. Brown, Denver, Col. Filed March 20, 1905.

807,870. Pole Changing Device. Harry O. Rugh, Chicago, Ill., assignor, by mesne assignments, to Edward C. Hennis, Sandwich, Ill. Filed June 2, 1902.

807,871. Electric Self-Playing Violin. Henry K. Sandell, Chicago, Ill., assignor to the Mills Novelty Company, Chicago, Ill. Filed March 27, 1905.

THE TELEPHONE WORLD.

No American Telephone Rights.

The stockholders of the American Telephone & Telegraph Company, at their special meeting last Thursday, approved by more than a two-thirds vote the resolution authorizing the directors to issue $150,000,000 convertible bonds from time to time as they may see fit. The total number of shares represented at the meeting was 1,438,136, of which 1,234,613 voted in favor of the proposition and 3,522 against it.

President Fish announced to the stockholders that the company as yet has no definite plans formulated for the proposed issue of $150,000,000 convertible bonds which was authorized, and made it clear that nothing in the way of "rights" would be likely to accrue to the stockholders as a result of the sale of the bonds, whenever such may take place.

President Fish in his remarks to the stockholders expressed the hope, as well as the belief, that the securities of the company, through the issue of these bonds, will find a wider market than they have met heretofore. "The condition of the company is to my mind satisfactory," he said, "and better than it ever has been before. One thing, however, which I do not like about our situation, and it is a matter of common gossip, is that we are a Boston concern. Boston and New England, much as I dislike to say it, are to-day in a way provincial, and not able to handle with entire satisfaction big enterprises which require large sums of money and a broad market for the securities. I am inclined to think that, if matters are carried out along the lines now planned, the securities of the American Telephone & Telegraph Company will find a market commensurate in breadth with the importance of the company, and its financial requirements. What its developments will be within the next 10 or 15 years, you may judge for yourself from what it has accomplished in the past."

The organization of the Citizens' Telephone Company of Caldwell, O., was lately consummated with the following incorporators: H. W. Kunz, V. K Herlan, J. A. Lemmax, Edward Spannagel, Charles H. Dew, L. W. Wheeler, J. H. Sparling, Florence Meek, E. S. Wilson, H. R. McClintock and William Simmins. The capital stock of $30,000 is held by the above named persons and the application for a charter was duly made. The board of directors has secured options on the property of the Farmers' Exchange Telephone Company of Caldwell and the Summerfield Telephone Company of Caldwell, and will take over those plants January 1, 1906. Just what the future development or business plans that this new company has in view were not made public, but it expects to fulfill the contracts of the respective companies at Summerfield and Caldwell.

The Independent telephone company is now in operation between Cooperstown and Oneonta, N. Y.

The Bath, Ky., Home Telephone Company capitalized at $15,000, has lately been organized.

The Rural Telephone Company of Edinburg, Pa., has been formed with $5,000 capital stock.

Independents Take Place of Bell Company.

A merger of the telephone exchanges of Tampa, Fla., has been announced whereby the Southern Bell Telephone Company abandons the local field, its plant, equipment, business and franchises being acquired by the Peninsula Telephone Company, the Independent company which has been operating in that city for several years.

The Ruston, La., city council has passed an ordinance granting permission for the use of the streets of that city for the construction of a new telephone service. A number of prominent citizens are behind the enterprise, and a canvass of the city shows that the merchants are unanimously in favor of organizing a home company. Enough stock to secure the new company has already been pledged.

The Black Springs, Ark., Telephone Company lately issued articles of incoporation. The capital stock is $5,000, of which $1,000 is subscribed. a ny is organized for the purpose of operating telephone lines in Montgomery and adjoining counties. J. A. Abernathy is president, W. C. Warren vice-president, C. C. Welsh, secretary, and W. C. Rowton, treasurer.

The Western Ohio Telegraph & Telephone Company, with headquarters at Toledo, O., and a capitalization of $100,000, was recently granted a charter by the Department of State. The incorporators are: John Meilink, A. C. Stevenson, F. E. Palmer, J. W. Davis and Joshua Lindall. The concern will do a general telephone and telegraph business with the termini of the lines at Toledo and Cincinnati.

At a recent meeting of the Thomson, Ga., city council, the local telephone system was leased from the stockholders with the privilege of buying the property later. The capital stock of the company will be increased and many needed changes will be inaugurated. The action of the council was in line with the views of the present administration, that all public utilities should be owned by the town.

The Independent telephone company of Fulton County, Gloversville, N. Y., has been formed to erect a telephone line. Its capital stock is $5,000 and incorporators: Frederick M. Young, Gloversville; William T. Briggs and Judson Baker, both of Johnstown, and others.

It is announced that the Automatic Electric Company of Chicago has recently received orders approximating 25,000 telephones. At the same time the business of the current year is quoted at $1,500,000. The automatic instruments have been installed in more than 75 towns and cities in the United States.

According to a report from Nashville, Tenn., the capitalization of the Cumberland Telephone & Telegraph Company is to be increased 20 per cent. January 2, 1906.

The Christion County Telephone Company of Taylorville, Ill., has increased its capital stock from $10,000 to $250,000.

Telephone Association to Meet in June.

James B. Hoge, president of the National Interstate Telephone Association, has given out the information that the next convention of the association would be held in St. Louis, Mo. Mr. Hoge thought that the convention would be held sometime in June, although the exact date has not been decided.

A new telephone company has been incorporated in Hammondsport, N. Y., known as the Pleasant Valley Telephone Company, with a capital stock of $5,000. This company combines nearly all of the rural lines entering the village. The stock will be taken by the 56 subscribers. The officers are: President, J. W. Brundage; vice-president, William Dildine; secretary, Pierre Brundage; treasurer. James H. Smelle. The lines are connected with the exchange there and with the Inter-Ocean at Bath and Penn Yan.

At the annual meeting of the Delaware Valley Telephone Company, held in North Sanford, N.Y., the following men were elected directors: J. W. Smith, E. E. Crane. C. A, Philley, U. D. Bailey, L. E. McCully, A. Colvin, D. D. Jones, Elmer Mills, Clark Henderson, C. B. Teed, C. W. Sampson, George Ireland and Floyd Gardiner.

Although the system of Independent telephone lines in Texas is composed of a large number of small units, the work of handling long distance business is very efficiently handled. All the companies work in perfect harmony, and a very satisfactory service is given.

The Eastern States Telephone & Telegraph Company of No. 15 Exchange Place, Jersey City, N. J., has been formed to construct electric telegraph, telephone and cable lines. Its capital stock is $1,000,000. The incorporators are: Henry A. Bingham, Cornelius A. Cale and Alex. F. Garbe.

The Reliance Telephone & Telegraph Company was lately incorporated in Jersey City, N. J., with a capital stock of $125,000. The incorporators are: Arthur Johns, Lanier McKee and Kenneth K. McLaren.

The Cameron, W. Va., Telephone Company has extended its lines to Garrison, Pa., where it connects with the Wadestown and Blackville lines, giving through connections with Morgantown and eastern points.

The Driftwood Telephone Company is to build a line from Capron to Alva, Okla. The company now has a line from Kiowa to Capron.

The Brooten, Minn., Telephone Company has been organized with a capital stock of $10,000. T. O. Shelso is president; A. A Mahlum, vice-president; and M. Reine, secretary.

The Diamond State Telephone Company is arranging to put in a party line for the farmers between Salisbury, Md., and Delmar, Del.

GENERAL ELECTRICAL NEWS.

LIGHTING.

Bartlett, Tex.—The Bartlett Electric Light & Motor Company has been incorporated with a capital stock of $10,000 by R. S. Decker, R. G. Decker and W. R. Decker.

Batavia, Ia.—Ottumwa parties are interested in an electric light plant to be installed here.

Birdsboro, Pa.—An electric light plant is to be erected along the Schuylkill River in this city.

Brighton, Ala.—This town is to be lighted by electricity. Negotiations have been opened between the authorities here and the Birmingham Railway Light & Power Company.

Chicago, Ill.—Mayor Dunne has made public his intention of securing lower and more uniform electric light rates for the people of this city. He has directed City Electrician Carroll to gather data on the cost of maintaining incandescent lights. The mayor has already conferred with William G. Beale, general counsel for the Chicago Edison Company, and declares his belief that electric light rates are too high, besides being characterized by discriminations.

Cleveland, O.—Mr. Springhorn will ask the city council to appropriate money for the purchase of electric light globes, wires and poles, in order that the new city lighting plant can be run to its fullest capacity.

Creighton, Neb.—The citizens have organized a stock company, capitalized at $25,000, for installing an electric lighting plant.

Creston, Ia.—The Creston Mutual Electric Light, Heat & Power Company has been incorporated here.

Ellicottville, N. Y.—This town will soon have electric lights.

Fayetteville, Tenn.—B. E. and J. W. Holman, J. H. Thompson and T. W. Caudle, of this city, and W. J. Holman, of Huntingdon, have purchased the electric light plant at Dayton, Tenn., and a charter has been applied for. The capital stock of the company, which will be known as the Dayton Electric Light Company, will be $10,000. Improvements amounting to $2,500 will be made on the plant at once. J. W. Holman is president; B. E. Holman, secretary and treasurer; W. J. Holman, superintendent; T. W. Caudle, general manager.

Fremont, Neb.—The citizens are agitating the question of moving the electric light plant, which is soon to undergo improvements, including the installation of four new boilers, and it is believed the present is the proper time for the consideration of moving it.

Houston, Tex.—The Houston Electric Company has added $500,000 to its capital stock.

Killeen, Tex.—McDowell & Burks, of this place, have secured a 50-year franchise from the city to operate an electric light plant.

Marceline, Mo.—The Marceline Electric Light Company has been incorporated with a capital stock of $20,000 by George W. Early, William P. Callahan and Henry B. Early, to operate an electric light plant.

Ottawa, Ont.—The people of this city have invested $200,000 in a municipal electric lighting plant.

Pittsburg, Pa.—There has recently been organized in this city the Chemical Light, Heat & Power Company, a corporation chartered under the laws of the State of New York, with a capital stock at present of $500,000. This capital, however, is purely nominal, and in a short time will be increased to either $1,500,000 or $2,000,000. This company is chartered for the purpose of taking over and acting as a holding company for gas and electric light and power plants. The company was promoted by J. Francis Horton, who has been elected president of the company. The capital stock is about evenly divided between Pittsburg and Eastern capitalists.

Standish, Mich.—W. W. Vaughn has made application for a franchise to install an electric lighting plant in this city to succeed the one that has just expired.

St. Augustine, Fla.—It is generally believed now that this city will be supplied with electric lights within the next mouth or so.

Tarentum, Pa.—The directors of the Young Men's Christian Association have decided to put in an electric light plant.

Walkerton, Ind.—This place is to have electric lights. The question was decided at an election lately held here for that purpose. There were but seven votes against it, while 160 favorable ballots were cast.

STREET RAILWAYS.

Alliance, O.—It is stated by Stark electric officials that the Alliance-Cleveland electric line will be built, and that C. R. Morley of the Stark Electric Company will be one of the leading promoters.

Arkansas City, Kan.—The citizens of this place and Winfield are quite bent on having an electric railway built between the two cities.

Burlington, Vt,—Capitalists interested in electric railways will petition the Vermont Legislature for a charter for the Champlain Valley Electric Road Company. The route is through this city, Shelburne, Charlotte, Ferrisburg, Vergennes, Panton, Addison, Bridport, Shoreham and Orwell, with an ultimate outlet at Rutland. This road will be in competition with the Rutland Railroad and will do freight as well as passenger business.

Cincinnati, O.—The long-expected merger of the great trolley roads of Indiana and Ohio is to be accomplished shortly. Recent information from Indianapolis states that the Cincinnati, Dayton & Toledo, the Tucker-Anthony lines, the Columbus, Buckeye Lake & Newark, the Columbus, Cincinnati & Newark, and the Dayton, Springfield & Urbana will be the Ohio lines involved. The deal involves millions. The money is supplied by the Randall-Morgan and Widener-Elkins interests.

Corning, N. Y.—The Erie Railroad Company has decided to adopt electricity on portions of its system, also maintaining the present steam equipment. A third track will be built between this city and Binghamton, with cut-outs, which will be run with the modern electric equipment. Eventually, probably a large part of the Erie's system will be adapted to electricity, and this first section is meant as a trial.

Georgetown, British Guiana.—The Demerara Electric Company, operating the electric traction system of this city, has decided to overhaul its power plant, rolling stock and roadbed during the next six months in order to put everything in first-class shape. The interests that own the Trinidad Electric Company have acquired control of the Demerara Electric Company, and F. W. Teele has been appointed manager and consulting engineer to carry out the improvements.

Guthrie, Okla.—The Logan County board of commissioners lately granted a franchise to Thomas A. Smith to construct an electric line northward from this city, and to be known as the Newkirk, Tonkawa & Southern Electric Railway. The company must deposit a bond for $1,000 before the franchise is effective. The proposed line will run through Logan, Noble and Kay Counties, and is intended to connect here with the Guthrie-Oklahoma City Interurban, and at Chilocco with the Gueda Springs electric line.

Hutchinson, Kan.—Emerson Carey and Charles Williams, representing a score or more of local capitalists, have purchased the Hutchinson Street Railway Company and will change the present horse car line into an electric line. A company is being formed to finance the road.

Lamonte, Mich.—This city is soon to have a new electric road.

Lansing, Mich.—The syndicate composed of James R. Elliott, of this city, and Myron W. Mills and George T. Moore, of Port Huron, has acquired a controlling interest in the Battle Creek Kalamazoo Interurban Trolley Line, as well as in the lines in Battle Creek and Kalamazoo City. The lines now connected by a number of projected extensions are to be reorganized as the Michigan United Railways Company. Lansing will be the center of the new system.

Omaha, Neb.—Right-of-way for an electric road has finally been secured from Albright to Bellevue by the Omaha & Council Bluffs Street Railway Company. Contractors are already figuring upon the grading, and bids to do that work are expected to be in shortly.

Parkersburg, W. Va.—A charter has been applied for by the Middlebourne & Ohio River Railway Company for the purpose of constructing an electric line from Sistersville to Middlebourne. The company is composed of local people and John Shrader of Chester.

POWER PLANTS.

Grand Detour, Ill.—Another big dam is to be built across Rock River just above here by the Sandusky Cement Company for the purpose of securing electric power for its cement mills east of Dixon.

Lewistown, Ill.—The Fisher Power, Heat & Electric Lighting Company of this city has been incorporated with a capital stock of $20,000, by Floyd M. Condit, Theodore Fisher and H. W. Masters.

Prosser, Wash.—The county commissioners have granted a franchise to the Prosser Falls Land & Power Company to erect a power line along the county road to the western boundary. It is for the purpose of transmitting electric power to Sunnyside for lighting that city, and also to furnish its power, with which to pump water for the town.

Spokane, Wash.—The Washington Power Company of this city has secured a franchise permitting it to introduce electric power for any purpose into any part of Whitman County.

NOTES FOR INVESTORS.

Latest quotations for copper are: Electrolytic, 18½@18⅝c. Lake 18⅝@18⅞c.; casting, 18@18½c.

New York Metropolitan Street Railway's regular quarterly dividend of 1¾ per cent. will be paid on stock January 16.

The General Electric Company has applied to the New York Stock Exchange to list $6,034,100 additional capital stock.

The Westinghouse Electric quarterly dividend of 2½ per cent. on the preferred assenting and non-assenting stocks is payable January 10.

The gross earnings of the Cleveland Electric Railway Company will be $5,300,000 for the present year, an increase of $550,000 over those of last year.

The National Carbon Company has declared a dividend of 2 per cent. on its common stock, an increase of one-half of 1 per cent. over the previous payment.

The Electric Storage Battery Company has declared the regular quarterly dividends of 1½ per cent. on its common and preferred stocks, both payable January 2.

The directors of the Bell Telephone Company of Philadelphia have decided to recommend to the stockholders that the capital stock of the company be increased from $16,000,000 to $30,000,000.

Judge Quarles, in the United States District Court at Milwaukee, has sustained the demurrer of the Milwaukee Electric Company of West Allis, Wis., against which a petition of involuntary bankruptcy was filed October 12 by Chicago and Milwaukee parties. The petition was dismissed.

The New Orleans Railways & Light Company has declared its first qarterly dividend under the reorganization of 1¼ per cent. on the preferred stock, payable January 15 to holders of record December 30. It is the policy of the company to hereafter declare quarterly dividends regularly at the same rate.

The Easton (Pa.) Consolidated Electric Company has levied an assessment of $5 a share on its stock, payable March 1. The company has also declared a dividend of $2.50 a share, payable on the same date. The dividend is to be credited by the treasurer on account of the assessment to holders of record February 17.

There is as yet no clear explanation of the minor details of the arrangement that will be made for the merger of the Interborough and the Metropolitan lines of New York. The reports heard in Wall Street are that the stock of the Metropolitan Securities Company, which now pays no dividend, was to be put on a 5 per cent. dividend basis and that the new holding company may take over the Securities Company stock by agreeing to pay this dividend. The same company could lease the Interborough lines by agreeing to pay a dividend rate on that stock acceptable to its holders. Any company taking over the Metropolitan Securities Company will have to assume all the obligations of that company, the chief of which is its guarantee of the Metropolitan Street Railways 7 per cent. dividend. Any permanent disposition that may be made of the Metropolitan Securities Company would apparently involve the calling of the balance of 50 per cent. that remains unpaid of the stock. It would thus be made full-paid stock instead of being subject, as it is now, to further assessments. The only official statement made about the merger is that no plans involving the traction companies would be consummated without affording every shareholder equal participation.

ELECTRICAL STOCK QUOTATIONS.

STREET RAILWAY STOCKS.

Name.	Closing price Dec. 27
New York City.	
Broadway and Seventh Avenue	243½
Interborough Rapid Transit	211
Manhattan Elevated Railway	163¼
Metropolitan Street Railway	125¾
Metropolitan Securities	81
Ninth Avenue	195
Third Avenue	125
Twenty-third Street	410
Other Cities.	
Brooklyn Rapid Transit	89⅛
Brooklyn City Railway	243
New Orleans Railway	39
Public Service Corporation (New Jersey)	115
Philadelphia.	
Consolidated Traction of New Jersey	83
Philadelphia Traction	100⅞
Union Traction	62½
Boston.	
Boston Elevated	153
Massachusetts Electric Companies, com	15¾
do. do. do. pref	60½
West End Street, com	98
do. do. do pref	113½
Chicago.	
City Railway	205
North Chicago	85
Union Traction, com	12
do. do. pref.	40½

ELECTRIC MANUFACTURING COMPANIES' STOCKS.

Name.	Closing price Dec. 27
New York City.	
Allis-Chalmers, com	22
do. pref.	62
Electric Boat, com	30
do. do. pref.	70
Electric Vehicle, com	15
do. do. pref.	20
Westinghouse, com	176
do. pref.	190¼
General Electric	177¼
Boston.	
Edison Electric Illuminating	239
General Electric	177½
Westinghouse Electric & Mfg., com	85½
do. do. do. pref.	100
Chicago.	
Chicago Edison	168
National Carbon, com	80½
do. do. pref.	116
Philadelphia.	
Electric Company of America	11½
Electric Storage Battery, com	81
do. do. do. pref.	81

TELEPHONE AND TELEGRAPH STOCKS.

Name.	Closing price Dec. 27
Boston.	
American Telephone & Telegraph Company	135
Western Telephone Company	13½
New England Telephone Company	134
New York.	
American Telegraph & Cable Company	90
Commercial Cable Company	210½
Mexican Telephone Company	1⅝
New York & New Jersey Telephone Company	160
Postal Telegraph Cable Company	..
Western Union Telegraph Company	92¾
Chicago Telephone Company	138½

MISCELLANEOUS STOCKS.

Name.	Closing price Dec. 27
Chicago Subway	47½
Otis Elevator Company	60
Standard Underground Cable	..
Twin City Rapid Transit	116½

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It is the desire of the management of this paper to bring the unemployed and employer together to their mutual benefit, and to this end they invite the former to make use of this column without charge. No advertisement exceeding five lines (about 25 words) will be inserted, but advertisers may write fully of their qualifications and these letters will be kept on file for future reference in filling vacancies which may occur.

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WANTED—Position by engineer-graduate with 9 years' experience in designing, manufacturing and marketing improved mechanical and electrical appliances; Chicago references. Address J. E., care Electricity.

WANTED—Position by a young man, age 21 years, in the office of a large electrical concern; one year sub-station experience; good knowledge of bookkeeping and electricity. Address E. M. C., care Electricity.

WANTED—Position with electrical company around electrical machinery or at installing and wiring; experienced at inside and outside wiring; age 21; student of International Correspondence Schools; can furnish references. Address J. H., care Electricity.

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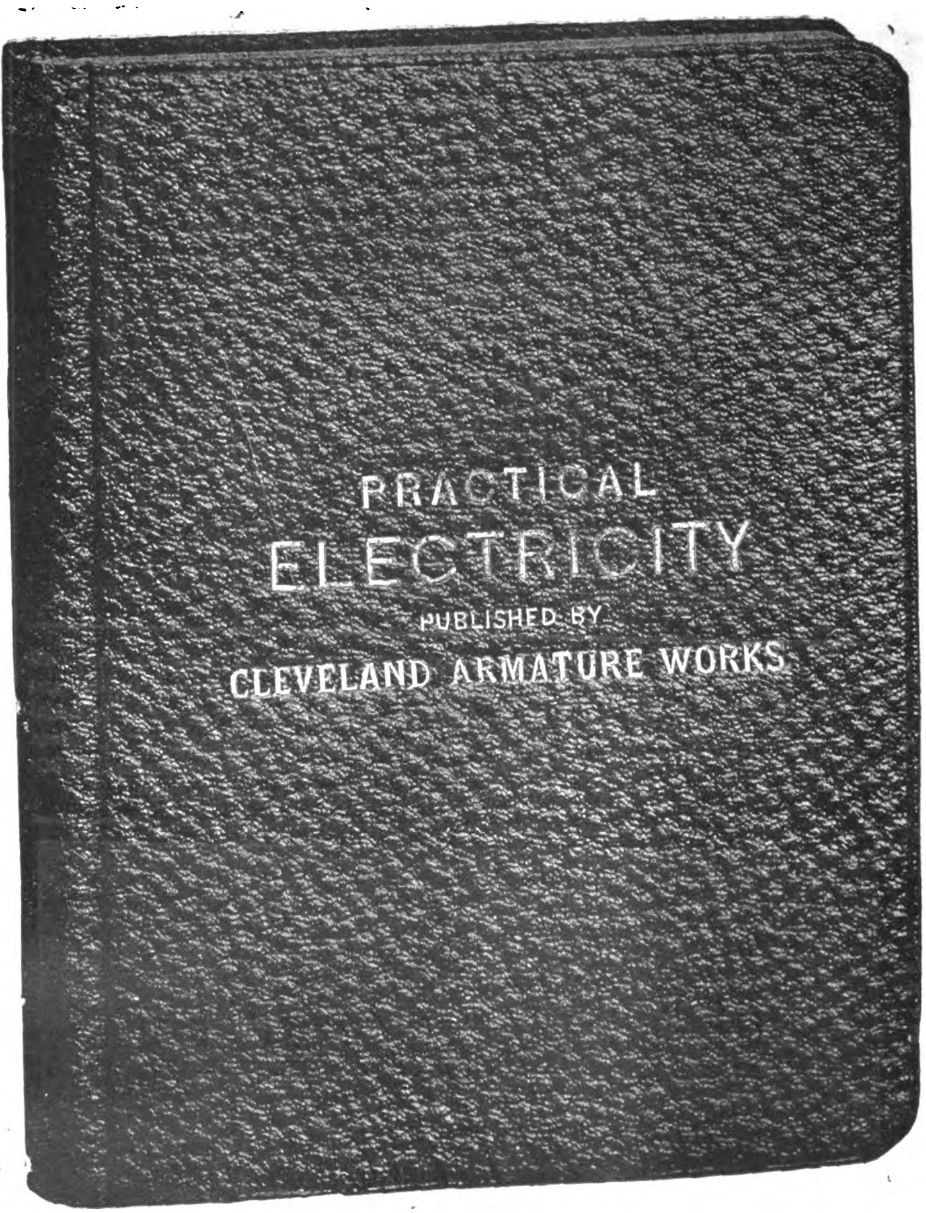

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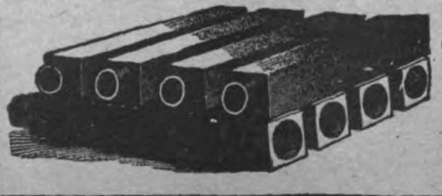

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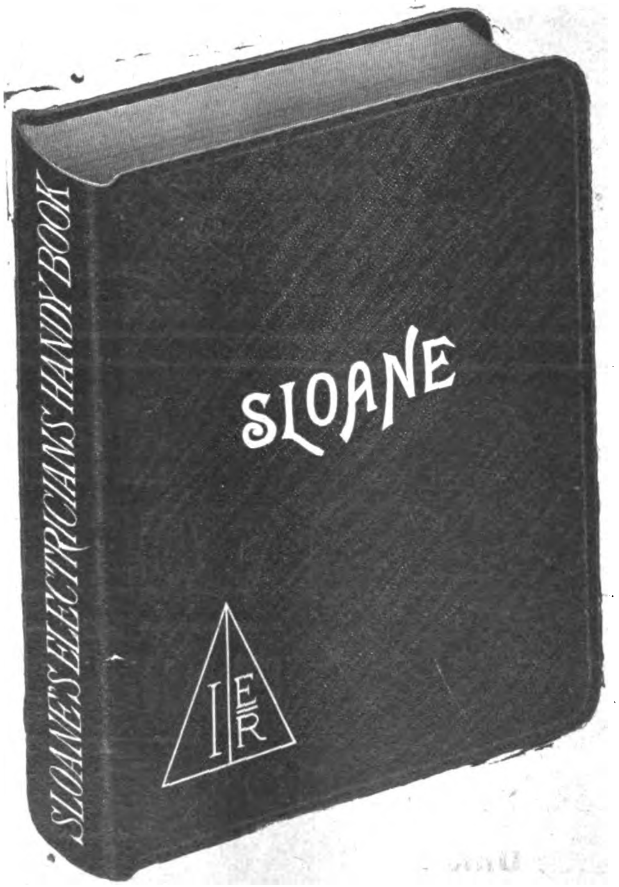

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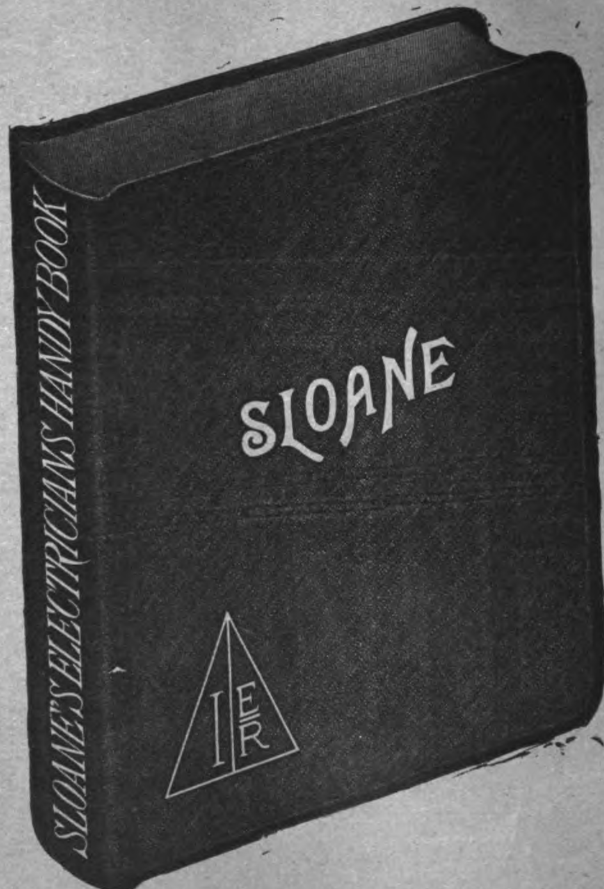

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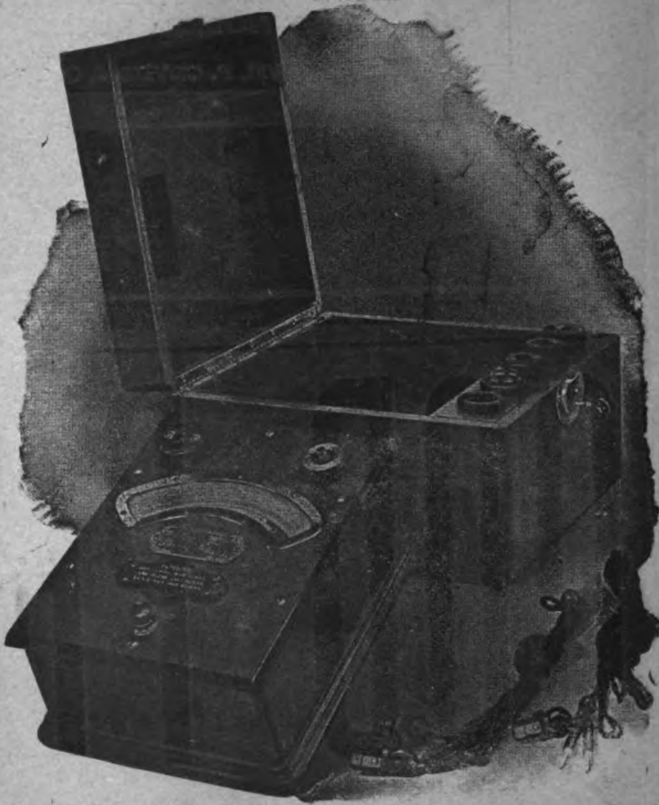

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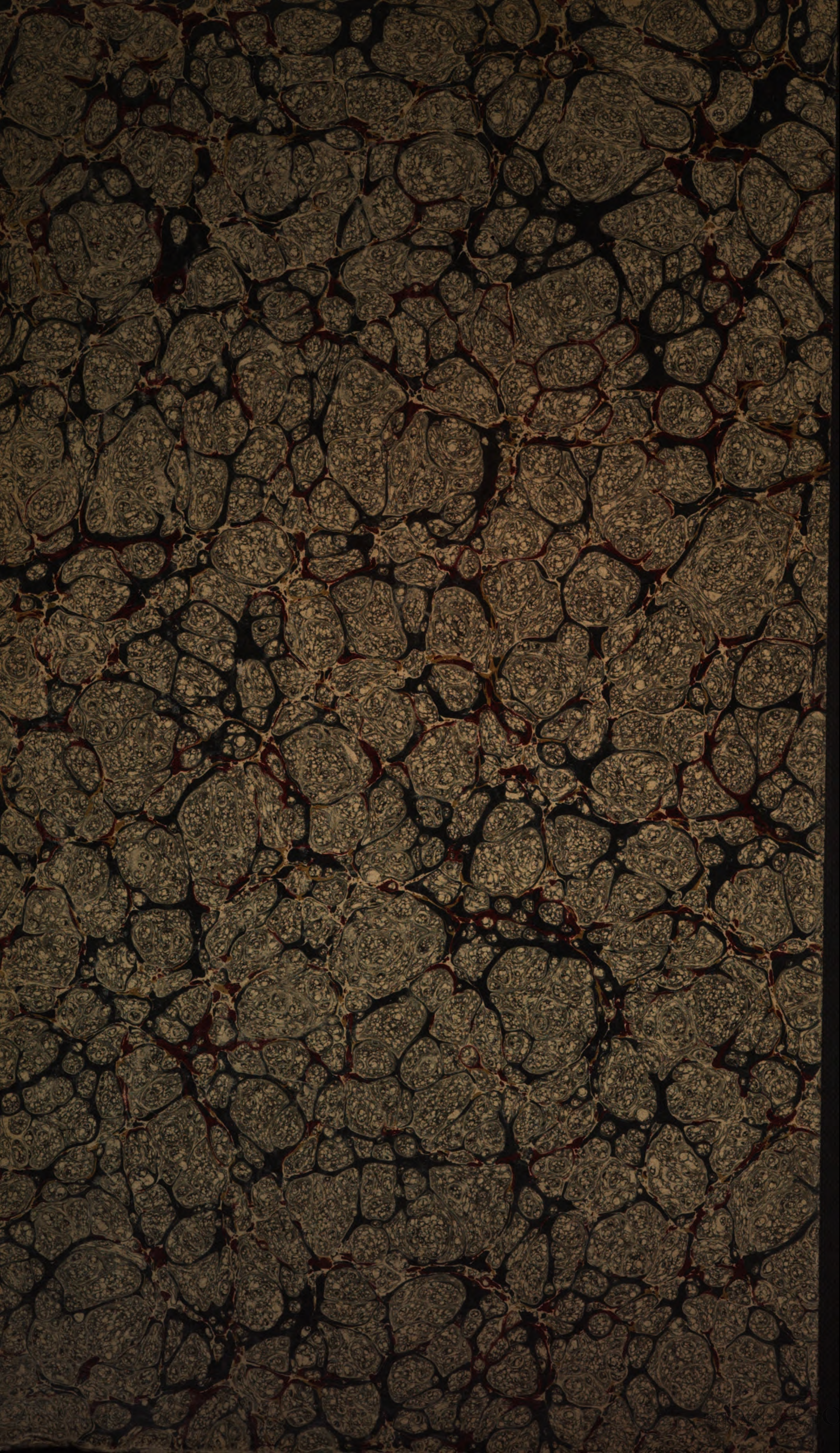

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